# INTEGRATED PEST MANAGEMENT MANUAL FOR HOME AND GARDEN PESTS IN BRITISH COLUMBIA

BRITISH COLUMBIA

**Ministry of Environment, Lands and Parks**

Pollution Prevention and
Remediation Branch

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# Integrated Pest Management Manual For Home and Garden Pests in British Columbia

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**Ministry of Environment, Lands and Parks**
Pollution Prevention and
Remediation Branch

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## Disclaimer

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Due to changes to labels, laws and regulations that occur over time, the British Columbia Ministry of Environment, Lands and Parks assumes no liability for the suggested use of pesticides contained herein.

No pesticides can be used unless they are registered in Canada for the intended use and bear a *Pest Control Products Act* registration number. At all times, pesticides must be applied according to the label directions on the pesticide container.

**Acknowledgements**

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Suzanne Clary
Alan Vaudrey and Bob Lucy of PES Professional Ecological Services Ltd.

Thanks are also owed Stuart Craig, Dick Heath and Scott Austin for editorial review.

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# Preface

## Why This Manual Was Prepared

This manual was prepared to help train people who sell pesticides to domestic pesticide users. Domestic users are people who buy pesticides for use in their own yards, gardens and homes. They often do not know how to identify and manage pests or how to mix and apply pesticides. Therefore, the emphasis in this manual is on providing dispensers with information they need to advise customers on how to manage pests as well as on safe pesticide use.

This manual is also intended to be used as a reference book for home and garden pest management. It should serve as a guide for both dispensers and customers. Vendor outlets are encouraged to display this manual in a handy location so that customers can use it as a reference. Users of domestic pest management products may find it useful to obtain their own copy.

The approach to managing pests being promoted by the BC Ministry of Environment, Lands and Parks is called Integrated Pest Management (IPM). IPM programs are based, first and foremost, on preventing pest problems; controls are only used when inspections show that a pest problem has reached a point that requires treatment. When controls are needed, first consideration is given to non-pesticidal controls and then to low-toxicity pesticides that give domestic users good results. IPM programs protect peoples' health and the environment by minimizing the use of pesticides.

This manual describes the IPM principles as they apply in a practical way to pest problems found in homes and gardens. It also discusses general pesticide terminology; the importance of pesticide labels; safe procedures for storage, transport, mixing, application and clean-up; environmental protection issues; and application equipment. In addition there are reference sections that list the characteristics of commonly used domestic pesticides and recommendations on how to manage the most common pests in homes and gardens in BC. The commonly used pesticides and the common BC pests were selected for inclusion in this manual based on a questionnaire sent to BC pesticide vendors.

The information contained in this manual is a large departure from previous dispenser training and will be new to many dispensers and their customers. At this time, only the most progressive vendor outlets may stock the full range of pest management products and recommended pesticides described. Informing the public about how to get good results managing pests, while using methods that protect their health and the environment, will need to be an ongoing process. For many people, that process will start with their exposure to the information in this manual. It will then take time to adopt a new way of thinking about dealing with pests, to educate customers and to make changes in inventories.

This manual is now included in the study package for the certification of dispensers selling Domestic class pesticides in BC. It adds a large IPM component to the training, which will be tested on the certification examination. Candidates studying for dispenser certification will be expected to

have a good understanding of the information in this manual. However, for people who specialize in pest management, this manual should really be seen as a starting point. In particular, pest managers should have as much knowledge as possible about the biology of pests and should keep informed about advances in management methods. Some references are included at the end of the manual for further information.

We hope that we have included the most useful pest management and pesticide information in this manual. However, this is the first attempt at a manual specifically for home and garden pest management in BC, so there may be unforeseen omissions and errors. We would appreciate receiving comments that will help us improve future editions of this manual.

## How The Manual Is Organized

This manual is divided into three main sections.

### Section I—IPM and Pesticide Safety

*Section 1* includes chapters 1 to 6. This section describes Integrated Pest Management methods as they apply to managing pests around homes and yards. Preventive strategies and the range of controls methods are reviewed. There are also chapters on pesticide characteristics, laws regulating pesticide use, guidelines for safe use, including storage, handling, mixing, applying, and disposing of Domestic class pesticides.

### Section II—Common Domestic Pesticides

*Section 2* includes chapters 7 to 10. This section contains chapters on insecticides, herbicides, fungicides, rodenticides, and other pesticides commonly used around homes and gardens. The basic chemical properties are described along with notes on safety and handling, precautions and environmental impact information.

### Section III—Common Home and Garden Pests

*Section 3* includes chapters 11 to 15. This section contains entries on common insect pests, weeds, plant diseases, and animal pests in BC yards and gardens. Each entry describes the pest and summarizes the information on life cycle and biology that would be important in managing a pest problem. Preventive methods and least-toxic alternatives for dealing with each pest are described first, followed by methods of last resort for extreme situations.

### To Help You Study

Each chapter has learning objectives at the beginning and study questions at the end. The learning objectives are there to guide the learning, and the study questions are meant for review. A glossary of terms is included at the end of the manual to define technical words used in the text.

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CHAPTER 1

# WHAT IS INTEGRATED PEST MANAGEMENT?

## Learning Objectives

When you have completed this chapter, you should be able to:

1. *Define Integrated Pest Management (IPM) as it applies to home and garden pest problems.*
2. *List the five main steps in an IPM program.*
3. *Explain the importance of correctly identifying pests.*
4. *Explain how visual inspections are used in monitoring pest populations.*
5. *Define injury level and describe how treatment actions relate to injury levels.*
6. *Describe common pest prevention methods and give examples.*
7. *Describe four types of pest controls and give examples.*
8. *Describe problems arising from pesticide use.*
9. *Explain the role of the pesticide dispenser in ensuring safety of customers and staff at the vendor site, and in providing information about IPM for customers.*

## Introduction

The intent of this chapter is to clarify and standardize what is meant by Integrated Pest Management (referred to as IPM) as it applies to the home and garden sector. A dispenser that understands the concepts of IPM will be able to pass on effective pest management information to customers, while helping them protect the environment and human health.

Integrated Pest Management is an approach that emphasizes prevention of pest problems and the use of least-toxic controls. IPM programs follow a decision-making approach to managing pests, starting with making sure pests are correctly identified. In an IPM program, treatments are only applied according to need as shown by a monitoring program, in contrast to regularly scheduled applications or "calendar" sprays. One or more types of treatment may be combined in an IPM program to provide the desired level of control and to prevent future pest problems.

Over the last 10 to 15 years, IPM methods have been successfully used to manage pests of all kinds, including plants, animals and diseases. IPM programs are increasingly used in forestry, landscapes and parks, and for household and garden pests. IPM programs continually improve as new products are developed and as information from research and practical experiences becomes available.

**General Definition of Integrated Pest Management**

The following definition was incorporated into the *Pesticide Control Act* (BC) in 1997.

"Integrated Pest Management" means a decision-making process that uses a combination of techniques to suppress pests and that must include, but is not limited to the following elements:

a) planning and managing ecosystems to prevent organisms from becoming pests
b) identifying potential pest problems
c) monitoring populations of pests and beneficial organisms, pest damage, and environmental conditions
d) using injury thresholds in making treatment decisions
e) reducing pest populations to acceptable levels using a combination of biological, physical, cultural, mechanical, behavioural, and chemical controls
f) evaluating the effects and efficacy of treatments

A complete IPM program based on the above description would be too complicated for most home and garden customers. There are several key IPM practices that dispensers should explain to their customers to help them achieve satisfactory, long-term control of pests.

## Components of an IPM Program

"An ounce of prevention is worth a pound of cure" is nowhere more true than in managing pests. Ideally, a pest management program starts with prevention. However, most customers asking for help almost always have an existing pest problem that must be dealt with before they can take preventive steps.

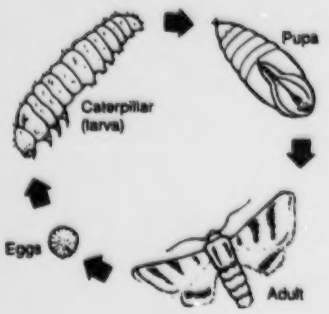
When customers ask for help with pests, a well-informed dispenser should be able to guide them through the basic steps of an IPM program. These are:

- identification
- monitoring
- action decisions
- treatments
- evaluation

## Identification

Before recommending any type of treatment, particularly a pesticide, it is essential to identify the problem correctly. First of all, it is important to determine whether or not there is a pest problem. In home landscapes and gardens, damage to plants is more likely to be caused by environmental conditions, such as drought, nutrient deficiency, sunscald, frost, salt or wind burn, dog urine, or mechanical damage, than it is from pests.

If a pest population is causing a problem, then it should be identified (to species if possible) so that information about it can be looked up in the Common Home and Garden Pest section of this manual, chapters 11-15, and in other references. The key to planning a control program that works is knowing the life cycle of the pest and the conditions that favour its development.



Moth Lifecycle

Learning about the pest helps customers to:

- know what to look for and where to look to keep an eye on the problem
- apply controls at the right time and place to be most effective
- plan an effective prevention program

When pest problems are identified based on plant damage, careful identification is essential because similar looking damage can have different causes. For example, curled leaves from a virus disease look much like damage caused by sucking insects. Spraying an insecticide would be useless if the plant symptoms were caused by a disease. Also, damage caused by nutrient deficiencies or poor growing conditions may be mistaken for signs that pests are present.

Identification is also important when customers have caught an insect they associate with plant damage. Often, it turns out to be to a beneficial species that was feeding on the pests that caused the leaf damage.

Identify pests by:

- comparing specimens with pictures in reference books or on the Internet
- recognizing characteristics of damage or of the excrement and castings left by pests
- consulting experts for assistance

It is very helpful to customers if the dispenser or someone at the vendor site is able to identify common pest problems, including plant disorders caused by poor conditions. This could benefit the vendor by attracting customers to use this service.

If the problem cannot be identified by the dispenser or other staff, customers should be directed to:

- master gardener clinics held periodically at local nurseries
- information lines run by Van Dusen Gardens (604-257-8662) and UBC (604-822-5858).
- reference books
- electronic resources on the Internet

**Note:** Provincial government staff do not provide identification services to the general public, however, nurseries and other businesses can send specimens to the provincial laboratory for identification and recommendations.

# Monitoring

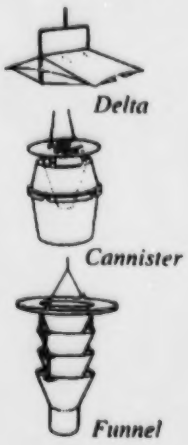
Monitoring consists of regular inspections to find out the extent of the pest problem and whether it is getting better or worse. A basic monitoring program would be a regular (daily or weekly) visual inspection coupled with written notes. People often notice plant damage after the pests that caused it are gone, therefore even a small amount of time spent on monitoring a problem can pay off by showing whether or not there is still a need for treatment.

More complex monitoring programs using sampling tools, such as insect traps, are available for commercial and hobby farms. For most home and garden customers the emphasis should be on making frequent, close, visual examinations to:

- detect problems while pest numbers are low and easier to control
- assess the size of the pest population and extent of damage
- look for conditions that contribute to the pest problem
- find out whether treatments are working

## Insect Monitoring Traps

*Pheromone traps*




**Sticky Traps:** Some insects are attracted to bright yellow or other colours so they can be caught on coloured sheets of plastic or cardboard that have been coated with sticky glue. Yellow sticky traps attract adult whiteflies, flower thrips, fungus gnats, leafminers and cabbage loopers. Bright blue traps are also available for flower thrips. Such sticky traps are usually used as a monitoring tool in greenhouses, although they can also be used as a control on indoor plants (see pg. 8 for Physical Controls). By regularly checking the sticky traps a gardener can find out when the first of the adult insects are present among the plants.

**Pheromone Traps:** Individually packaged pheromone attractant traps are available for monitoring some species of moths. The traps are baited with a lure that mimics the odour given off by female moths to attract males for mating. The traps are used to find out when the main flights of adult moths occur so that sprays can be put on at the right time to have the greatest effect. Orchard growers use traps to time codling moth sprays so that they are used when the most moth eggs are hatching into caterpillars. Pheromone traps would not be useful for most backyard gardeners, because the gardener would not know how to relate the number of moths caught to a need for treatments.

### Gardeners Beware! # 1

**Pheromone Traps:** Individually packaged pheromone attractant traps are now sold for pests such as codling moths and cabbage loopers. Some package labels imply "proven, effective" control of these pests in home gardens. Unfortunately, this is not possible with these traps alone because they only attract adult males. Since it is the females that lay eggs, the traps can not control a moth population.

# Action Decisions

Deciding when to take action and apply treatments is based on information obtained by regularly monitoring the pest situation. The key idea is that treatments are made only when and where monitoring shows they are needed and not on a pre-set schedule. This also means that pesticides would not be used just because it is a certain time of year (there are some exceptions, such as dormant oil sprays used in winter).

Injury level is the acceptable amount of injury or damage that could be tolerated from a particular pest population. In a home or garden, "injury" includes damage to the appearance of landscape plants, loss of fruit and vegetable crops, and sometimes health hazards posed by insects, such as yellowjackets. Without realizing it, people tolerate a certain amount of pest damage because they simply don't notice it. A close look at landscape plants, lawns, and gardens will always turn up a few plant-eating insects, weeds, and even some signs of disease, but this is rarely a cause for concern.

Often treatments are used where pests are causing little or no damage because the customer is afraid that the problem will spread or eventually kill the plant. The dispenser should be able to help customers determine which species pose a problem and which are of little concern. Dispensers can also reassure customers that even plants that look heavily damaged, for example from tent caterpillar attack, may suffer little long-term harm. They also should know that it is desirable to allow low numbers of pests to remain because they are food for the beneficial insects and birds that continue to keep pest numbers low. When pests are eradicated in a local area by pesticides, their natural enemies are either killed or move away because their food supply is gone. It is not uncommon for pest numbers to reach more damaging levels after pesticides are used because the natural enemies are no longer present to keep the pests in check (for example, aphids on fruit trees will often recover to higher than pre-treatment densities after use of an insecticide that kills aphid predators). This underlines the importance of using non-toxic methods for managing pests and highlights the role of the dispenser in educating customers.

It will be a new idea to many customers that treatments are not automatically required when low numbers of a "pest" species are found.

# Treatments

In domestic IPM programs, treatments generally fall into two categories: preventive measures and control measures.

## Prevention

The long-term goal of managing any pest problem should be prevention. This includes:

- planting pest resistant plants
- using barriers to keep pests out
- cleaning up to remove food for pests
- cultural practices that ensure healthy plants
- changes to the environment to make it less hospitable to pests

For example, lawns can be managed to prevent weeds from growing by using good turf management practices. This includes such steps as mowing at the recommended height (not less than 6 cm for most home lawns), using slow release fertilizers and correct watering practices.

### Selling Prevention

In addition to recommending pest resistant cultivars, there are a variety of products that dispensers can sell to customers to prevent pest problems. These include barriers, such as floating row covers, as well as other supplies, such as soil amendments and fertilizers, to grow healthy, pest resistant plants.

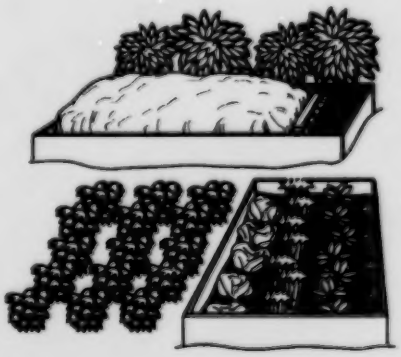
In homes and gardens, preventive methods alone are often sufficient to keep most pest populations at tolerable levels. These methods also make other controls more effective and help prevent the recurrence of problems.

**Resistant Plantings:** Gardeners can choose those plants that are least susceptible to attack by insects or disease. These may be naturally hardy and pest-free plants, such as many native plants, or they may be cultivars that have been selected for resistance.

Examples include:

- roses resistant to black spot, powdery mildew, and rust (see pg. 150-151)
- grapes, squash and cucumber resistant to powdery mildew (check descriptions in seed catalogues)
- rhododendrons resistant to black vine weevil (see pg. 131)

**Barriers:** Barriers keep pests away from plants. Although they may take time and effort to install, once in place they usually require no further effort.



Examples of barriers are:

- tar paper squares, laid around the base of cabbage plants to prevent root fly from laying eggs
- screens on doors and windows to keep out flies

- floating row covers over carrot beds to keep out carrot rust fly
- sticky bands on tree trunks to catch female winter moths and prevent them from laying eggs on trees

**Sanitation:** Removing food and water sources and eliminating nesting and over-wintering sites can be very effective in preventing pest problems. Common sanitation steps include:

- cleaning up spilled food in cupboards to remove food for pests
- keeping garbage tightly covered to discourage ants and rodents
- checking new plants (before buying) to make sure they are not diseased or infested with insects
- picking up and destroying early dropped fruits, which are often infested by insects

**Cultural Practices:** Also called cultural controls, these are measures that ensure that plants are healthy and well-suited to the site. This can make a big difference in how well plants grow, their susceptibility to diseases, and how quickly they recover from damage. For example:

- select plants that are adapted to the conditions where they are to grow (soil type and drainage, shade or sun, exposure to wind or salt spray)
- use proper watering, fertilizing and other cultural practices

**Changing the Environment:** When conditions that favour pest populations are removed or changed it can go a long way toward discouraging pests. For example:

- aerating lawns to improve drainage deters the growth of moss and some species of weeds
- drying out structural wood that has become damp, through leaks or direct contact with the soil, prevents carpenter ants and dampwood termite infestations
- composting kitchen and garden wastes in rodent-proof bins reduces rodent populations

## *Controls*

Ideally, controls are only called for where preventive measures have not been sufficient.

> Usually customers come to the dispenser for advice about an existing pest problem. They need to deal with the immediate problem before they can move to a prevention program.

Generally controls for home and garden pests fit into four main types:

- physical controls
- mechanical controls
- biological controls
- chemical controls

These controls may be used separately or in combination for greater effectiveness. When deciding which controls to choose, consider those that are:

- least hazardous to human health
- least toxic to other non-target organisms (for example, pets, fish, and beneficial insects)
- least damaging to the environment
- most likely to provide a long-term solution
- most likely to be used correctly by the customer
- most cost-effective in the long run to the customer

## *Physical Controls*

Physical controls include mulches, sticky insect traps and rodent traps as well as using hoeing or hand pulling to control weeds. Freezing dry food products to kill stored product pests would be a physical control, as would using boiling water to kill weed seedlings growing in sidewalk cracks.

Sticky traps for insects can be used both as a monitoring tool and as a physical control. It is possible to control whiteflies or fungus gnats on indoor plants if enough yellow sticky traps are placed among the plants.

### Gardeners Beware! # 2

**Apple Maggot Traps**: These sticky red ball traps work well to capture adult apple maggot flies, but so far, this species has not been found in BC Although at times some garden centres have sold them, these traps are for a pest we don't have. Other insects get caught on the apple maggot traps, but since they aren't the target pest, there is no benefit to killing them.

## *Mechanical Controls*

Mechanical controls are machines or equipment used to control pests. These include vacuum cleaners, ultra-violet light traps, cultivators for weeds, and string weeders.

### Gardeners Beware! # 3

**Ultra-sound Repellers:** These are not legal to be sold in Canada for insect control, because they do not work on insects. Periodically, however, a mail order source or local supplier springs up to sell these devices to the unwary. There is evidence that rats and mice do hear ultra-sound and are initially repelled by it, therefore the devices are registered for rodent control. However, research has also shown that rodents eventually get used to the sound and are likely to return, especially if there is a food supply available. Using repellers for insects, such as fleas, cockroaches, mosquitoes, or flies, does not work because studies have found that these insects do not have the ability to hear ultra-sound.

## *Biological Controls*

Biological control is the use of living organisms that are the natural enemies of pests to control pest populations. Many of these natural enemies are beneficial insects and mites, but they can also be animals, such as birds and snakes, or even micro-organisms, such as beneficial soil fungi and bacteria.

Home gardeners can employ biological controls by:

- protecting the many beneficial species that are native to BC
- buying beneficial species (insects or mites) from commercial suppliers

**Protecting Native Beneficial Species:** The most important way to protect beneficial species is to avoid using pesticides as much as possible, especially chemicals that affect a wide range of species or that are very long lasting.

If pesticides are needed as part of a pest management program, then the user should:

- select products with the lowest toxicity, such as insecticidal soap, and/or shortest residual effect, such as pyrethrins
- limit the applications to only those plants or areas that are infested

Native beneficial insects can be attracted to home gardens by growing plants that provide them with pollen and nectar. Many adult female beneficial insects must have nectar or pollen to give them energy to lay eggs. Once the females are attracted to the garden, they are likely to stay and lay eggs. When the eggs hatch, the larvae that emerge prey on the pests. Recommended plants are those with small flowers, such as dill, parsley (a biennial), catnip, lemon balm, thyme, and other herbs, which provide food for tiny parasitic wasps. Daisies, coneflowers, and yarrow are good pollen sources for lady beetles and other predators. Alyssum, candytuft, marigolds, phacelia, schizanthus, and salvias are also good insect plants, as are some common weeds, such as dandelions, goldenrod, wild carrot, lamb's quarters, and wild mustard.

**Using Commercial Beneficial Species:** Beneficial species sold by commercial suppliers include micro-organisms, insects, mites, and nematodes. The main micro-organism currently available to gardeners is *Bacillus thuringiensis* (Kurstaki) or BTK (such microbial products are legally registered as pesticides, see pg. 75 for more information).

Most species of beneficial insects and mites are sold for use in commercial greenhouses. Many of these are also effective in hobby greenhouses, but only some of them are recommended for use outdoors.

Customers interested in using beneficial species should be aware that:

- most only attack particular species of pests, therefore the problem must be correctly identified first
- supplier instructions must be followed very carefully to ensure good results
- these living organisms are very perishable and must be handled carefully and released promptly

## Lady Beetles

Everyone has seen packages of lady beetles for sale in some garden centres. Most are the species *Hippodamia convergens* sold to control aphids. These are collected in California in the fall from large congregations of lady beetles that gather together to hibernate. When the beetles are released into a garden in the spring most of them fly away, even when there are aphids to eat, because their instinct is to disperse. You can temporarily stop the beetles from flying away by spraying them with clear soft drinks (such as 7-UP). The sweet liquid glues their wings together without harming them. This step may keep them around long enough to mate and lay eggs so that their offspring stay to control aphids.

Also consider there are many native lady beetle species already present in BC and these cost nothing to provide aphid control. Lady beetles are being scooped up out of their home range in large numbers to sell

Harvesting lady beetles is not an ecologically sound practice and may not continue indefinitely.

Recently, some garden centres have been stocking the multicoloured Asian lady beetle, *Harmonia axyridis* . These are less likely to fly away when released, but because they are becoming an increasingly common species in many areas of southern BC, it is likely they are already in many gardens.

## Table 1: Biological Controls for Home Gardens and Greenhouses

| Pest Problem | For Outdoors Gardens |
|---|---|
| Aphids | Aphid midge (*Aphidoletes aphidimyza*)<br>Multicoloured Asian lady beetle (*Harmonia axyridis*) |
| Spider mites | Predatory mites (*Amblyseius fallacis*)<br>(also various other species) |
| Root weevil larvae and Leatherjackets | Insect parasitic nematodes<br>(*Steinernema* and other species) |
| | **For Greenhouse Plants** |
| Aphids | Aphid midge, multicoloured Asian lady beetle.<br>Aphid parasite (*Aphidius matricariae*)<br>Convergent lady beetle (*Hippodamia convergens*) |
| Spider mites | Predatory mite (*Phytoseiulus persimilis*) |
| Whiteflies | Greenhouse whitefly parasite (*Encarsia formosa*)<br>Predatory beetle (*Delphastus pusillus*) |
| Mealybugs | Australian lady beetle (*Cryptolaemus montrouzieri*) |
| Scale, Soft brown | Predatory beetles (*Lindorus lophanthae*)<br>(rarely available) |

### Gardeners Beware! # 4

**Praying Mantid Egg Cases:** Adult mantids are large insects capable of eating many insects. Egg cases are sold in stores, but they are rarely still alive when they are finally taken home. If the eggs do hatch, the tiny mantids often die immediately if sufficient prey is not immediately available. Those that survive eat anything, including many beneficial insects and butterflies. Although a fascinating pet to keep in a terrarium, mantids are not recommended for release outdoors in British Columbia.

## *Chemical Controls*

A huge variety of substances, mostly chemicals, are registered as pesticides in Canada. Pesticides are any substances that are used to kill, control, repel, or manage insects, rodents, fungi, weeds and other living things that are considered to be pests. Pesticides vary greatly in their toxicity and the way they work (see Chapter 2).

### Problems with Pesticide Use

Much of the increasing interest in IPM stems from the undesirable side effects of pesticide use, including:

- development of pest populations that are resistant to pesticides
- exposure of people, pets and other non-target organisms to potential health hazards
- environmental contamination by pesticides

In comparison to other types of controls used in IPM programs, pesticides can:

- provide short-term control, but rarely a long-lasting solution to pest problems
- require careful planning to ensure proper storage of chemicals around homes
- create a waste disposal problem for the more toxic chemicals

When pesticides are necessary in a pest management program, the customer should have help in choosing the most appropriate pesticide and method of application. Pesticides should only be considered after careful assessment indicates their use is required, based on all the available information.

There are several approaches the dispenser can recommend to limit negative impacts of pesticides, such as:

- choose "preferred pesticides" where possible
- choose ready-to-use formulations, rather than concentrates
- choose application methods that limit the amount of pesticide used
- limit treatments to only the plants or site where pests are a problem
- notify anyone who could enter a treated area to prevent exposure to pesticides

### Preferred Pesticides

Preferred pesticides as described in this manual generally are those that:

- present the least short and long-term health risk to humans
- have the lowest environmental impact, due to the short residual effects and/or their specificity to target pests

The characteristics of specific preferred pesticides are described in Chapters 7, 8, and 9 of this manual.

### Other Pesticides

Products containing toxic and/or persistent chemicals, such as organophosphorous and carbamate insecticides, are registered for use around homes and gardens. These may be necessary in some cases, particularly as a short-term measure to deal with an immediate pest problem. Generally, however, these products should not be recommended to home and garden users when preferred pesticides are available. This is because of the risk of harming non-target organisms and the hazard associated with improper storage and disposal. Also, there is increasing concern that some of these

chemicals disrupt hormone functions in humans and animals. These are known as endocrine disrupters.

For customers buying such products for larger areas, such as hobby farms, it is recommended that they obtain a pesticide applicator's certificate in the appropriate category (courses are offered by community colleges and other local trainers). It is essential that all customers planning to use such products know what safety equipment they need to use and that the pesticides must be used according to instructions on the label.

Characteristics of specific pesticides are discussed in Section II.

## Evaluation

This step in the IPM process is important because it helps people decide what worked for them and what didn't, so they can identify ways to improve their results. In particular, the customer should keep records of pesticides used and treatment dates. They should be encouraged to keep notes on the pest situation before they treat so that they can be compared with observations made after treatment. These notes will also help them in future years to decide whether or not treatments are necessary and when to take preventive steps.

## IPM: Role Of Dispensers

Although the final responsibility for pesticide use is with the person applying the pesticide, the dispenser must be available to help choose products and advise on their use. The dispenser should:

- ensure the safe display and storage of pesticides at the sales area
- ensure customers know that pesticides should be used only according to the directions on the label
- be able to advise on pest prevention and management methods

Dispensers should be prepared to help customers make informed decisions about pest management, and should introduce them to IPM methods as the most effective way to achieve results. Dispensers should be able to direct their clients to non-chemical methods or recommend preferred pesticides (see Section III). The use of least toxic controls reduces the safety and environmental hazards associated with pesticides, and ensures there is less risk from storing pesticides around the home.

Most customers appreciate being told about safer control products. They also appreciate a dispenser that recommends only what a customer needs, based on a positive identification of a pest or problem. Vendors can profit from the sale of other pest management products besides pesticides, while at the same time improving customer relations by giving sound pest management advice. This will result in customers recognizing the vendor as an authority on pests and pest management, not as just a place to buy pesticides.

# *Study Questions: Chapter 1 - What is IPM?*

*Answers are given at the back of the manual.*

1. For each statement in Column A, choose the best match from Column B.

| Column A | Column B |
|---|---|
| __ sticky trap | a. ineffective mechanical devices, not legal to sell in Canada for insects |
| __ barriers | b. mulching, hoeing or hand pulling weeds, rodent traps |
| __ Integrated Pest Mgmt. | c. regular visual inspections and written notes |
| __ preferred pesticides | d. prevention of pest problems and use of least-toxic controls |
| __ pest identification | e. least-toxic products with low impact on non-target organisms |
| __ ultra-sound repellers | f. screens, floating row covers and tree bands |
| __ monitoring | g. cardboard coated with glue |
| __ physical controls | h. using beneficial species to control pests |
| __ biological control | i. essential first step in an IPM program |

2. What are the five components of an ideal IPM program?
3. Describe three ways to identify pests.
4. What is the purpose of monitoring?
5. What is an injury level?
6. Why is prevention so important for home and garden pest problems?
7. What is biological control? Give one example of a beneficial species that would be useful in a home garden.
8. List three unwanted side effects of pesticide use.
9. What is a preferred pesticide? Give two examples.
10. What three things should the dispenser be able to do to help customers select products and use them correctly?

CHAPTER 2

# PESTICIDE CHARACTERISTICS AND LEGISLATION

## Learning Objectives:

When you have completed this chapter you should be able to:

1. *Describe the main federal regulations that apply to pesticides.*
2. *Describe the five categories of pesticides in the Pesticide Control Act Regulation.*
3. *Describe the certification requirements for sale and application of Domestic pesticides in BC.*
4. *Describe when pesticide use permits, pest management plans, vendor licences and service licences are required.*
5. *Describe storage and display requirements for Domestic pesticides.*
6. *List key requirements for safe transport of pesticides.*
7. *Describe approved methods of disposing of left over pesticides.*

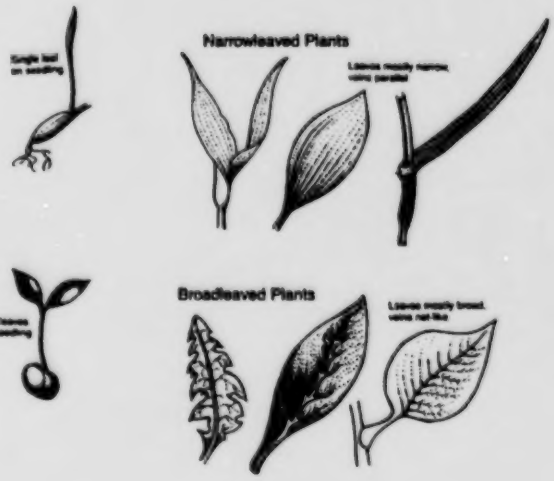
## Introduction

There are many types of pesticides. This chapter gives an overview of how pesticides are classified, common ways they are formulated and how they are labelled. Specific laws regulating pesticide use are also described in this chapter. These laws are aimed at protecting people and the environment because most pesticides are toxic substances.

## Types Of Pesticides

Pesticides are grouped according to the type of pests they are used for. Thus insecticides are for controlling insects, and herbicides are for controlling plants.

Some pesticides have **broad-spectrum** (or **non-selective**) activity, meaning they control many species, whereas others, called **selective** pesticides, only work on certain species. For example, a broad-spectrum herbicide kills any plant, whereas a selective herbicide kills only certain broad-leafed plants and not grasses.




How a pesticide works on the pests is called the **mode of action**. Some pesticides are **stomach poisons**, meaning the pest has to eat it to be affected. Others act upon **contact**, meaning the pest dies if it comes into contact with the pesticide. How long the pesticide remains active against pests after it is applied is called its **residual effect**. Some pesticides remain active for days or weeks, while others, such as soap or oil sprays, act only on pests hit by the spray and have no residual activity after the spray has dried. Pesticides with residual effects are also **persistent**, meaning they remain active in the environment for a period of time, even if rain or wind has carried them away from the target site. A few Domestic pesticides have **systemic activity**. This means that the pesticide is absorbed into the plant and moves through the plant tissues. A systemic insecticide can move throughout a tree to kill sucking insects on the leaves, while a systemic herbicide applied to the leaves can move down to the roots to kill the plants. The properties of commonly used home and garden pesticides are described in Section III.

## Pesticide Names

Pesticides are usually referred to by either the common name of the **active ingredient** (the ingredient that has the pesticidal effect), or by the **trade name** of a particular product. For example, Roundup® is the trade name of a herbicide product that contains the active ingredient glyphosate. Active ingredient names are used in this manual to reduce confusion, because the same active ingredient can be used in many different products. For example, there are over 490 products registered in Canada for home and garden use that contain pyrethrins, a group of compounds extracted from a type of daisy. Some pyrethrin products are dusts, while others are liquids. Some are for garden use, while others are for use on pets, depending on how they are formulated. In addition to the active ingredients, product formulations also contain other ingredients. These include carriers for the active ingredients, such as water, oil, solvents, inert powders, and other substances that improve the way a product mixes with water or makes it stick to plants once it is sprayed.

## Pesticide Labels

Pesticide product labels are legal documents with instructions and precautions that must be followed. See the examples of two pesticide labels on the following pages. The labels show certain essential information the user needs to know before buying, using or disposing of the product. These are:

1. **Guarantee:** This states the common name of the active ingredients and the amount in the product. This is usually shown as a percentage of the total weight (for example, 20%) or the weight of the active ingredient per volume of product (for example, 200 grams per litre of a liquid).

2. **Use and Classification:** The type of pesticide, such as herbicide, fungicide, or insecticide, is stated on the label. Pesticides meant for household use also have the word **DOMESTIC** in bold face type on the container label. This refers to the federal classification system for pesticides, which has three categories of use: Domestic, Commercial and Restricted classes. Domestic class products are the only ones that should be sold for household and garden used. These often have the same kinds of active ingredients found in Commercial pesticides, but the active ingredient is usually more diluted and therefore less toxic. There is a wide range in the toxicity of Domestic pesticides, however, and some of these are dangerous if handled incorrectly.

### Federal Categories of Pesticides

**Domestic:** Includes ready-to-use products and small-sized containers of concentrates more suitable for the small areas of use around homes and gardens.

**Commercial:** These include more toxic pesticides as well as products in large size containers intended for commercial users (such a landscape service or an agricultural grower). They are to be used by commercial applicators who have the knowledge and training to handle such products.

**Restricted:** These are products that are more hazardous or involve special requirements for use. They are not for home and garden users; even commercial users must be certified to use these.

3. **Formulation**: The type of formulation inside the container is usually stated under the trade name on the label. This may be written out or abbreviated. It is essential to check the formulation before buying a pesticide to ensure that it contains the type of product required. For example, dust formulations are often confused with wettable powder formulations.

### Formulation Abbreviations on Labels

**Dusts** (D or DU): These dust products are used as they come from the container and are not mixed with water.

**Granules** (G or GR): The pesticide is incorporated into tiny beads made of clay or other material, such as mixed fertilizer-herbicide products for lawns.

**Pellets** (PE): The pesticide is incorporated into larger pieces than granules, such as rodent bait pellets.

**Wettable powders** (WP): These are especially formulated to be easy to mix into water and are intended to be used to make a spray.

**Emulsifiable concentrates** (EC): This is the most common type of liquid concentrate formulated so that it can be mixed with water to make a spray.

**Aerosols** (A): These are ready-to-use sprays in small, pressurized containers, such as wasp and hornet sprays.

**SAMPLE (FICTITIOUS) PYRETHRINS LABEL**

**For Tomato and Vegetable Insects**

To Control Aphids, Beetles, Cabbageworms, Leafhoppers, Loopers, Whiteflies, And Other Insects As Listed.

**Read The Label Before Using.** **Keep Out Of Reach Of Children.**

**DOMESTIC**

REG. NO. 222222 P.C.P. ACT Net Contents: 700 mL

GUARANTEE: Pyrethrins 0.02% / Piperonyl butoxide 0.20% Piperonyl butoxide 0.20%

Generic Products Inc.
1000 Somewhere Street
Atown ON

READ ENTIRE LABEL. USE STRICTLY IN ACCORDANCE WITH LABEL PRECAUTIONARY STATEMENTS AND DIRECTIONS.

TO CONTROL: Aphids, Asparagus Beetles, Blister Beetles, Cabbage Loopers, Cross-Striped Cabbage Worms, Colorado Potato Beetles, Diamond-back Moth Larvae, Flea Beetles, Harlequin Bugs, Imported Cabbage Worms, Leafhoppers, Leaf Tyers, Mexican Bean Beetles, Stink Bugs, Twelve-spotted Cucumber Beetles, Webworms, Whiteflies.
ON: Asparagus, Beans, Broccoli, Brussels Sprouts, Cabbage, Cauliflower, Celery, Collards, Eggplant, Kale, Lettuce, Mustard Greens, Peppers, Potatoes, Radishes, Spinach, Tomatoes, Turnips.

HOW TO USE: Apply this spray to provide thorough coverage of upper and lower leaf surfaces. Repeat treatment weekly or as needed throughout the growing season. Also can be used in greenhouses. Do not apply to crops within one day of harvest.

PRECAUTIONS: Harmful if swallowed or absorbed through skin. Avoid breathing vapours or spray mist. Avoid contact with skin and eyes. Remove pets, birds, and cover fish aquaria before spraying. Keep from freezing (above 0 degrees C).

ENVIRONMENTAL HAZARDS: This product is toxic to fish. Do not apply directly to water. Do not contaminate water by cleaning of equipment or disposal of wastes.

DISPOSAL: Do not reuse empty container. Discard with household garbage.

FIRST AID: If in eyes or on skin, flush with plenty of water. If irritation persists, obtain medical attention. If accidentally swallowed, obtain medical attention at once.

Seller's guarantee shall be limited to the terms set out on the label and subject thereto, the buyer assumes the risk to persons or property arising from the use or handling of this product and accepts the product on that condition.

DISCLAIMER FOR THIS FICTITIOUS SAMPLE LABEL: This sample label uses selected information made available by the Pest Management Regulatory Agency. This sample label is not complete for any specific product. Only the official hard-copy label should be referred to for assurance of complete information when using a product

**SAMPLE (FICTITIOUS) METALDEHYDE LABEL**

**LIQUID SLUG & SNAIL KILLER WITH METALDEHYDE**

**Keep Out Of Reach Of Children. Keep Away From Domestic Animals (Dogs And Cats Are Attracted To This Product) Read The Label Before Using.**

WARNING POISON

**DOMESTIC**

REG. NO. 111111 P.C.P. ACT. NET CONTENTS: 280 mL
GUARANTEE: METALDEHYDE.....20%

GENERIC Products Inc.
1000 Somewhere St.
Atown, ON, B.C.

These contents will make 45 L of dilute spray, enough to cover 94 $m^2$ of area. Liquid slug & snail killer destroys slugs that crawl over surfaces which have been sprayed. Unlike a bait, it does not have to be eaten by the slug to be effective. Good results are obtained by applying the spray to areas adjacent to slug hiding places, killing slugs as they migrate to food sources.

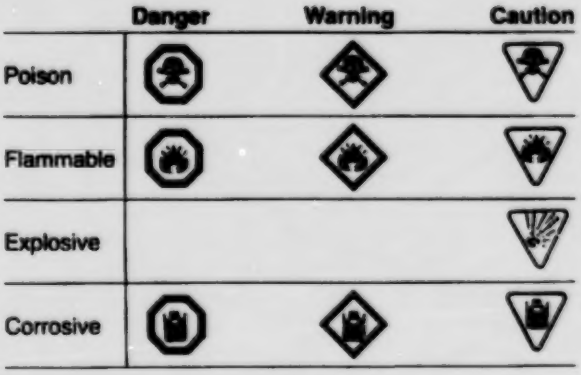
DIRECTIONS FOR USE: Shake before using. Mix 30 mL (2 tablespoons) of Liquid Slug & Snail Killer to 5 L of water and apply to 10 $m^2$ of area. Do not allow animals to graze on treated area within 1 - 2 weeks.
LAWNS & ORNAMENTALS: May be applied with a sprayer or a sprinkling can. Apply to areas frequented by slugs. The spray may be applied to the foliage of ornamentals.
VEGETABLES: Spray a barrier ring around your vegetable garden to protect it from outside invasion. One litre of spray will make a barrier 30 cm wide by 7 m long.
DO NOT SPRAY ON THE EDIBLE PARTS OF VEGETABLES.

PRECAUTIONS: KEEP OUT OF REACH OF CHILDREN, POULTRY AND DOMESTIC ANIMALS. Avoid inhalation of the spray mist. Keep away from eyes. Avoid contamination of food and feedstuff. Protect contents from freezing. Do not store in direct sunlight or near food. Do not contaminate lakes, ponds, streams or rivers.
FIRST AID: if swallowed, induce vomiting by giving 2 glasses of water to drink and inserting finger into the mouth and touching the back of the throat. Repeat until vomit fluid is clear. Call a doctor or poison control center immediately. Never give anything by mouth to an unconscious person. If in eyes, flush with water for 15 minutes and get medical attention.
If on skin, remove contaminated clothing and wash skin with soap and water.
TOXICOLOGICAL INFORMATION: Ingestion may cause intestinal irritation, and kidney and liver damage.
STORAGE: Keep product in original container. Store in a cool, dry place away from food.
DISPOSAL: Do not re-use empty container. Wrap container and discard in household garbage.
NOTICE TO BUYER: Seller's guarantee shall be limited to the terms set out on the label and subject thereto, the buyer assumes any risk to persons or property arising from the use or handling of this product and accepts the product on that condition.

DISCLAIMER FOR THIS FICTITIOUS SAMPLE LABEL: This sample label uses selected information made available by the Pest Management Regulatory Agency. This sample label is not complete for any specific product. Only the official hard-copy label should be referred to for assurance of complete information when using a product

4. **Precautionary Symbol**: This is shown on a label if the product may be hazardous to handle or use. The most common symbol seen on Domestic pesticides is the skull-and-crossbones, which means "poison." Other symbols warn of flammable, explosive or corrosive properties.

   **Note:** symbols surrounded by a stop sign outline denote high or extreme danger.




5. **Directions for Use:** These contain the manufacturer's directions for using the product, including what pests it controls, what type of plants or sites it can be used on and mixing instructions, if mixing is required.

6. **Precautions and First Aid:** These sections describe protective clothing or equipment required and other safety precautions for protecting the environment and non-target organisms. The First Aid section contains instructions for treating a victim of accidental poisoning. This information is not included on labels of products with such low toxicity that first aid would not be required.

# *Pesticide Legislation*

Because most pesticides are toxic materials, there are specific laws regarding their use aimed at protecting people and the environment.

Pesticide legislation includes laws:

- protecting fish and wildlife
- governing safe transport and disposal
- specifying how pesticides can be sold

There are also laws to protect the consumer from false claims about what a product will control and to ensure that label information is accurate and complete.

The pesticide dispenser should be able to explain how these laws protect the customer, and how the customer and store must protect the environment.

**Note:** Legal requirements only are outlined in this chapter. Additional pesticide safety guidelines are described in Chapter 3.

## Federal Registration

Under the *Pest Control Products Act,* all pesticides must be approved by Health Canada[1] before use or sale in Canada. Approval by Health Canada is shown by a Pest Control Products (PCP) registration number on the label. A product without this number or with only an United States EPA number on the label cannot be legally sold or used in Canada.

The *Pest Control Products Act* requires a broad range of tests to determine effects on non-target organisms, potential for movement in the environment, and that the pesticide is effective when used as directed.

Under the federal *Act,* pesticides are assigned to one of three classes, which is indicated on their label:

- **Domestic:** generally lower toxicity product formulations that are sold in small containers for home and garden use.
- **Commercial:** generally more toxic products and concentrates that are sold in larger amounts for commercial use.
- **Restricted**: uses are restricted due to hazard and are for use by certified applicators only.

Pesticides must be labelled with specific use directions and with warnings of hazards. A label is a legal document and an applicator must follow all label directions.

## Federal Requirements to Protect Fish and Birds

There are federal laws for the protection of fish and birds. For example, it is unlawful to apply or dispose of pesticides in a way that may harm fish, such as releasing a pesticide into a lake or stream. Vegetation growing along the edges of lakes and streams also must be protected. These provide shade and food for fish.

Pesticides must not be applied to fields used as feeding or resting areas by migratory birds. It may be necessary for a dispenser to tell a customer that a pesticide cannot be applied near a lake or stream, or in a way that may harm birds. Some pesticides have specific precautions on the label about toxicity to fish or birds. These must be used with extra care, or avoided altogether, where there is risk of harm to wildlife.

[1] The responsibility for pesticide registration changed from Agriculture Canada to the Pest Management Regulatory Agency of Health Canada in 1995.

# British Columbia Pesticide Control Act

The *Pesticide Control Act* contains legal requirements for the sale, transportation, storage, mixing, application, and disposal of pesticides. Administering this *Act* is the responsibility of the BC Ministry of Environment, Lands and Parks.

Ministry of Environment, Lands and Parks staff investigate complaints of pesticide misuse. They issue Pesticide Vendor and Service Licences and inspect storage sites of pesticide vendors and service companies to ensure compliance with the regulations. They also review applications and issue Pest Management Plan approvals or permits required for pesticide use on public land.

Sections of the *Pesticide Control Act* most relevant to pesticide sales are described in the following paragraphs. Refer to the text of the *Act* and the Pesticide Control Act Regulation for complete legal definitions and details.

## Pesticide Classification

In the Pesticide Control Act Regulation, pesticides are divided into five categories called schedules. Each schedule has different requirements for sale and use; most are only for professional, certified pesticide users and not for the domestic, home and garden user.

## Permit-Restricted Schedule Pesticides

This group includes a number of pesticides that are now obsolete (no longer registered by Health Canada), such as DDT, chlordane, aldrin and dieldrin. In addition, this group contains a few pesticides for which use must be strictly controlled, such as calcium cyanide. They are listed in the Pesticide Control Act Regulation and require a permit from the Ministry of Environment, Lands and Parks for purchase and use. Their purchase and use requires a pesticide applicator certificate. None of these pesticides are for domestic users.

## Restricted Schedule Pesticides

This group includes pesticides federally labelled as Restricted. There are use restrictions on the label. Their purchase and use requires a pesticide applicator certificate. None of these pesticides are for domestic users.

## Commercial Pesticides

This group includes pesticides that are federally labelled as Commercial. They are intended for general commercial use, such as farming or forestry. They are not intended for domestic users.

## Domestic Schedule Pesticides

This group includes pesticides that are federally labelled as Domestic class. They are intended for use by non-professional, domestic users, in or around buildings and gardens. They are generally sold in small containers so the contents can be used up in one or two seasons of use.

## *Exempted Schedule Pesticides*

This is a group of pesticides listed in the Pesticide Control Act Regulation. They are specified Commercial and Domestic pesticides that are exempted from regulatory requirements for sale and storage. Some common Exempted pesticides are listed in the table below. Most Exempted pesticides are federally labelled Domestic products. A few can be either labelled Commercial or Domestic.

**Note:** It is important for the dispenser to keep in mind that Exempted pesticides are not necessarily the least toxic control option for a given pest problem. Customers may mistakenly think that they are the preferred control method because they are sold by unlicensed stores. Information in this manual will help dispensers advise customers correctly. See the introduction to Chapter 7 for a definition of preferred pesticide.

### Table 2: Common Exempted Schedule Pesticides

The following federally labelled Domestic pesticides are included in the Exempted Schedule of the Pesticide Control Act Regulation*. Those marked with "C" also include Commercial as well as Domestic labelled products.

**GENERAL**

Pressurized pesticides (for example, aerosols)
Soaps (for insect or weed control) **C**
Swimming pool chemicals **C**
Cleansers, deodorizers and disinfectants **C**
Asphalt solids (pruning paint) **C**

**GENERAL INSECTICIDES**

Allethrin
d-trans allethrin
Insect bait stations (ant traps) **C**
Insect repellents (mosquito repellents)
Pyrethrins **C**
Rotenone **C**
Resmethrin
Tetrametrin
Boron compounds

Pet pesticides (flea shampoo, collars)

Silicon dioxide (diatomaceous earth) **C**

**ANIMAL REPELLENTS**

(for example, for dogs, cats, and deer)

**MOTH BALLS/FLAKES**

Paradichlorobenzene
Napthaline

**MOSS KILLERS**

Ferrous sulphate **C**

**PLANT GROWTH REGULATORS C**

(for example, root dip for cuttings)

**WOOD PRESERVATIVES**

(Includes zinc napthanate and copper napthanate, but does not include creosote)

***Note:** For a complete list, refer to the current Pesticide Control Act Regulation.

## Vendor Licences

A store where pesticides are sold must have a Pesticide Vendor Licence, obtained from the Ministry of Environment, Lands and Parks, unless the store sells only Exempted pesticides.

## Dispenser Certificates

To sell any pesticides (except Exempted pesticides) the vendor must have at least one certified pesticide dispenser present in the store for all hours the store is open. A certified dispenser is someone who has obtained training and received a dispenser certificate from the Ministry of Environment, Lands and Parks. This dispenser must be available to provide advice to any customer who requests help when purchasing a pesticide.

## When Consulted by a Purchaser

When a customer requests assistance in selecting a pesticide, the dispenser should first ask what the pest is, where it is, and assist in identification of the problem if necessary. The dispenser should also be able to suggest alternatives to pesticides and least-toxic products to aid the customer in making a suitable choice of controls. If necessary, the dispenser should check pest control recommendations in Section III of this manual or in the Ministry of Agriculture and Food publication *A Gardener's Guide to Pest Prevention and Control in the Home and Garden*, or other sources.

If the customer is advised to purchase a pesticide, the dispenser should check on the label to ensure the pesticide is registered for the use and location intended by the customer. The customer should be told of any potential hazards associated with the pesticide selected and be reminded to read the label.

## Pesticide Storage at the Vendor Site

Domestic pesticides may be displayed on open shelves in a store, provided they are at least 10 metres away from food or feed products. If this is not possible, pesticides the must be stored in a pesticide storage room that has:

- partition walls from floor to ceiling constructed of wood, fibreboard, plaster, or other solid material, separating air in the room from the remainder of the premises
- self closing door
- external ventilation by exhaust fan

The pesticides could also be stored in a separate building or room that meets these requirements.

Pesticides must be displayed and stored in their original containers, with a clearly legible label. The local Fire Department must be informed about the location of storage facilities and the quantities and nature of pesticides located there.

## Pest Control Service Licences

A Pest Control Service Licence is required by anyone providing a service using non-Exempted pesticides. The dispenser may be asked about this requirement. For example, if a person is a landscaper and purchases a pesticide for control of weeds or insects on a customer's property, the dispenser should advise that the landscaper must have a Pest Control Service Licence.

### Pesticide Use Permits and Pest Management Plans

Non-exempted pesticides must be used either under a Pesticide Use Permit or an approved Pest Management Plan when they are applied:

- on public land
- on private land used for forestry, transportation, or public utility purposes, such as rights-of-way
- to lakes, streams, or ponds

Any person applying pesticides, even Domestic pesticides, to these areas must also have a pesticide applicator certificate. This means that it is illegal for a home applicator to apply pesticides to public boulevards, roadside ditches, or lake weeds in front of a cottage, unless they have:

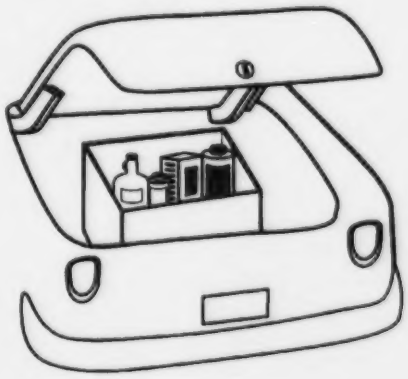
- a valid pesticide applicator certificate
- the treatments are authorized under a Pesticide Use Permit or Pest Management Plan

### Transportation

The following are legal requirements in the Pesticide Control Act Regulation for transport of pesticides:

- Secure pesticide containers sufficiently to prevent pesticides from spilling or escaping, and from being removed by an unauthorized person.

- Separate pesticides from other goods to prevent contamination of human or animal food, clothes, household furnishing and other items.



In practice, these requirements mean that pesticides should be kept out of the vehicle passenger compartment (for example, in a locked car trunk or box of a truck). Also, no one should be allowed to ride in the back of a vehicle carrying pesticides.

## Protection of Wildlife

Under provincial wildlife protection laws, it is illegal to use pesticides to poison wildlife. Recommended types of repellents, barriers and scaring devices are described in Section III. People with serious wildlife problems (such as racoons, deer, bats or birds) should consult a wildlife officer of the Ministry of Environment, Lands and Parks for recommendations.

## Waste Management Laws

Waste management is regulated under the *Waste Management Act,* which is administered by the BC Ministry of Environment, Lands and Parks. Regulations regarding disposal of waste or unwanted pesticide products are under this *Act.*

Under these regulations, the chemical industry has set up collection depots for leftover household hazardous wastes, which include Domestic class pesticides as well as solvents, gasoline and paint. Anyone wanting to dispose of Domestic pesticides with a skull-and-crossbones poison symbol on the label (such as many rodent poisons and liquid concentrates) should be told to take them to the nearest household hazardous waste collection depot. It is illegal to pour such pesticides down the drain or onto the ground where they can contaminate ditches, lakes or rivers. Collection depots have been established in the major centres across the province. Information on the location of these depots is available from the industry organization responsible for the waste collection program.

Empty containers of Domestic labelled pesticide may be disposed of in household garbage. Unwanted or waste domestic pesticides that do not have a poison symbol (skull-and-crossbones) on the label can also be disposed of in the household garbage.

Contact the Consumer Product Stewardship Program for more information or to find out the location of the nearest pesticide collection depot by calling:

**Lower mainland: 878-8700**

**BC wide: 1-800-505-0139**

**Note:** There is no BC regulation that prevents a vendor from accepting the return of an unopened pesticide container from a customer.

# *Study Questions: Chapter 2 - Pesticide Characteristics and Legislation*

*Answers are given in the back of this manual.*

1. For each statement in Column A, choose the best match from Column B.

| **Column A** | **Column B** |
|---|---|
| __ exempted pesticides | required by anyone providing a service using non-Exempted pesticides |
| __ Restricted, Commercial, Domestic | required by a store selling non-Exempted pesticides |
| __ Pesticide Service Licence | Federal pesticide classes identified on product labels |
| __ permit or Pesticide Management Plan | *Pesticide Control Act* schedules for pesticides |
| __ permit-restricted, Restricted, | no special licence or Commercial, Domestic, Exempted application certification is required for these pesticides |
| __ Pesticide Vendor Licence | required by an applicator applying non-Exempted pesticides on public land, private land used for forestry, transportation, or public utility, or into lakes, streams and ponds |

2. Describe the requirements for storing pesticides in a store that sells both animal feed and Domestic pesticides.

3. What is an Exempted pesticide?

4. What are two legal requirements regarding transportation of pesticides under the Pesticide Control Act Regulation?

5. What are the requirements for disposing of waste Domestic pesticide under the *Waste Management Act*?

6. A vendor decides to sell an aerosol spray product to repel mosquitoes. Does the store need a certified pesticide dispenser on staff?

CHAPTER 3

# PESTICIDE HANDLING GUIDELINES

## Learning Objectives

When you have completed this chapter, you should be able to:

1. *Describe why it is important to store pesticides correctly and list the requirements for pesticide storage and display areas.*
2. *List general safety precautions for transporting pesticides.*
3. *Describe the protective clothing and equipment an applicator should wear while applying pesticides.*
4. *List general safety precautions for mixing pesticides.*
5. *List general safety precautions for applying pesticides.*
6. *Be able to provide information on buffer zones, re-entry times, and days to harvest.*
7. *Describe how poor pesticide handling practices can harm the environment and list precautions for preventing environmental damage.*
8. *Describe safe disposal of empty pesticide containers and unwanted residues.*

## Introduction

Pesticides are used to kill or control animals, plants and other organisms. If they are not handled correctly they can also harm people, other non-target organisms, and damage the environment. Following the basic precautions described in this chapter will greatly increase the safety factor in using pesticides.

Pesticides vary greatly in toxicity, persistence and other characteristics. When a pesticide is called for to manage a pest problem, the dispenser should recommend the least hazardous products wherever possible to reduce the risk to people, pets and the environment. For recommendations on less hazardous pesticides (called preferred pesticides in this manual) refer to chapters on pesticides (Section II) and pest management (Section III).

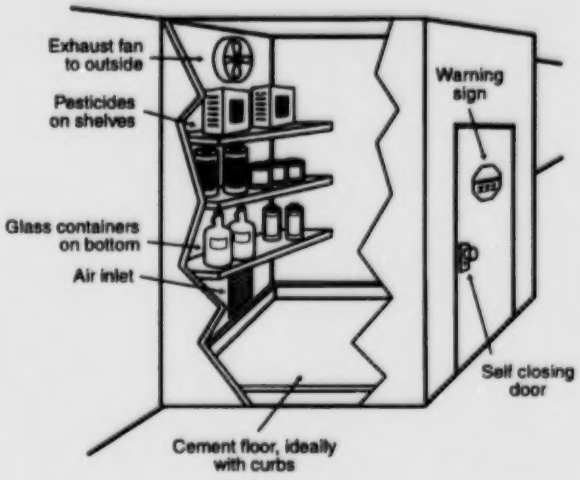
The first part of this chapter covers specific requirements for displaying and storing pesticides at the vendor site. This is followed by information and precautions a dispenser must know in order to answer questions from customers and help them handle pesticides in the safest manner possible.

# Storing Pesticides

## Storage at the Vendor Site

**Storage Area Requirements:** Legally, non-Exempted Domestic pesticides on display or stored by a vendor must be separated from human or animal food by a direct distance of 10 metres, or must be kept in a separate room. (Note: All Commercial class pesticides must be stored and displayed in a separate room).

When pesticides are kept in a separate room, the room must have solidly constructed partition walls from floor to ceiling, separating the air in the room from the remainder of the premises. The room must also have a self-closing door and be ventilated by an exhaust fan discharging to the outside of the building. The pesticides could also be stored in a separate building or room that meets these requirements.




A pesticide display area should be located where:

- people are unlikely to bump into the display
- children will not be able to reach the pesticides, or have easy access to them
- there is good ventilation
- it is away from areas where staff spend long periods of time

The temperature of pesticide storage areas should be moderate year around to ensure containers do not explode from heat expansion or break from freezing. Moderate temperatures also keep the products from degrading and losing effectiveness.

**Check Containers:** Containers of stored pesticides should be inspected regularly for damage and leaks. Leaking containers or spilled pesticides will contaminate the storage area. This could poison staff and customers if they come in contact with the spilled chemicals while handling the containers. Leaking containers can also cause environmental damage if, for example, the pesticides are discharged outdoors where they can be carried into ditches or storm drains.

**Note:** Large bags of lawn herbicide/fertilizer products should be handled carefully and checked thoroughly. They are particularly prone to splitting and spilling due to the weight of the bags. Spilled product can be tracked from the display area throughout the vendor site and into the vehicles of customers.

**Keep a Spill Kit:** A basic spill kit should be located near the storage or display site. It should contain absorbent material such as kitty litter, a plastic bucket with lid, a broom and dustpan, and decontamination materials. For information on how to handle pesticide spills, see Chapter 5 (pg. 62).

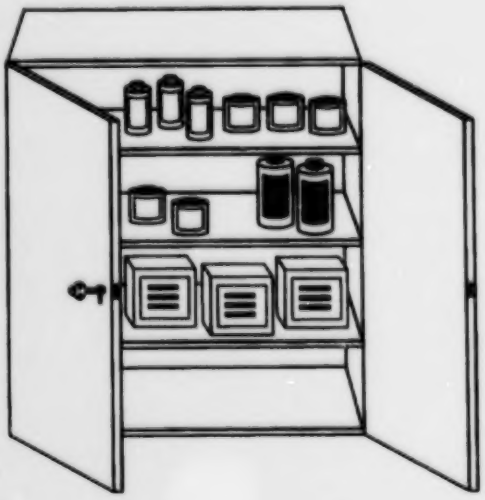
**Post Emergency Numbers:** Phone numbers of the local Fire Department, Police Department, Ambulance and Poison Control Centre and the Provincial Emergency Program (1-800-663-3456) should be clearly posted at the storage or display site in case of an emergency.

**Notify Fire department:** The fire department must be notified of the presence of non-Exempted pesticides, such as any Domestic or Commercial labelled products, on the vendor premises. This is a legal requirement.

**Note:** Exempted pesticides do not have to be displayed or stored separately from food. However, every effort should be made to prevent a customer from carrying such pesticides in the same bag or box as food or personal items.

## *Storage At Home*

The biggest concern with improperly stored pesticides around homes is accidental poisoning of children, although other people and pets are also at risk. Most calls to poison control centres involving pesticides are incidents where the exposure happened at home. Poisonings occur when pesticides are stored in a container without a proper label (such as a pop bottle), when pesticides are spilled and when they are handled incorrectly. If it is necessary to store pesticides, the dispenser should give advice to customers on safe storage procedures.



**Minimize Amount Stored:** The amount of pesticides to be stored should be kept to a minimum. Ideally, the customer should buy enough for one application or, at most, enough for only one year. Purchasing excess pesticide requires long-term storage, which increases the risk to people, pets and the environment. Also, some pesticides degrade over time and lose their effectiveness.

**Use Original Containers:** Pesticides should always be kept in their original containers with the label attached. Leaking pesticides, small amounts of pesticides or mixed pesticides should never be stored in food or beverage containers. Unsuspecting people (especially children) can, and do, drink pesticides by mistake, resulting in severe illness or death.

**Isolate Pesticides:** Pesticides must be put in a location where they are out of reach and will not be disturbed by people and pets. Pesticides must be stored away from working and living areas. It is

safest to store pesticides in a locked cabinet, shed or room, that is well ventilated. This should not be in a garage or outbuilding, however, where the containers are likely to freeze during the winter.

**Keep Cool and Dry:** The storage area should be cool and dry, and protected from sunlight, extreme heat and freezing temperatures. Sunlight and heat degrade pesticides and containers exposed to high temperatures will expand, which may cause them to leak or explode. Freezing can break containers and cause pesticide ingredients to separate.

**Inspect Regularly:** Stored pesticides should be checked for damaged or leaking containers. Spilled pesticides can contaminate the storage area and nearby household items. They may poison people or pets as they walk through the spilled pesticide or otherwise come in contact with it. Leaking pesticides also could cause environmental damage if they are released outdoors. If a container is found to be leaking, it should be placed in a larger container, such as a plastic bucket, to prevent more pesticide from spilling into the storage area. The new container must be clearly labelled with the pesticide name and active ingredients.

## *Transporting Pesticides*

Pesticides must be transported with care to avoid the possibility of spills. Spilled products may release toxic vapours, contaminate other goods and possibly poison people or pets exposed to the products. Also, contaminated materials, such as upholstery on car seats, are very difficult to clean properly. People usually do not realize how much cleaning is required to decontaminate such materials. The following precautions should be taken while transporting pesticides:

**Isolate Pesticides:** Pesticides should be placed in a separate bag or box. They must not be placed in a bag or box containing food, clothing, toys or other articles.

**Separate Pesticides:** In a vehicle, bags or boxes containing pesticides should be separated from people or placed as far away from people as possible. For example, they should be put into the trunk of a car, the rear portion of a van or in the back of a truck.

**Secure Pesticides:** Pesticide containers should be secured so that they cannot be broken or tipped over during transport. Ideally, the container should be placed in a box to ensure it won't move if the vehicle makes a sudden stop.

**Keep Pesticides Dry:** Pesticides in paper packaging must be kept dry. If a package gets wet, the pesticide may become caked or hardened. The wet paper may also rip, allowing the pesticide to spill from the bag.

**Lock Vehicle When Absent:** When transporting pesticides, the vehicle must be locked if left unattended to prevent children, or anyone else, from gaining access to the pesticides. Pesticides in the back of a pickup truck should be in a locked box.

# Protective Clothing and Equipment

Pesticides can enter the body through the skin, eyes, nose or mouth. The major route of entry into the body, however, is through the skin. Prevent exposure to pesticides by wearing suitable protective clothing and other equipment as required.

## Minimum Protection

The minimum protective clothing worn while applying pesticides should consist of:

- long-sleeved shirt
- long pants
- shoes and socks
- unlined chemical resistant gloves

**Note on Gloves:** Unlined chemical resistant gloves should always be worn when handling pesticides to protect the skin on the hands. Gloves made from neoprene or nitrile offer the best protection. Common household rubber gloves do not provide good protection from some pesticides. Never use leather, cloth, or lined rubber gloves, as these absorb pesticides and cannot be properly cleaned. Wearing contaminated gloves will result in pesticides being absorbed into the skin.

## Additional Protection

For some kinds of applications and under certain conditions, additional protective clothing and equipment is needed to protect the user. These include:

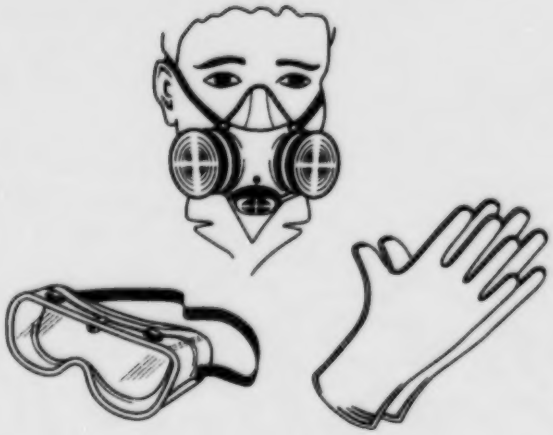
**Rubber Boots:** The user should wear unlined rubber boots if there is a chance that shoes could become wet with pesticide. Pants legs should extend down over the outside of the rubber boots to keep out pesticide.

**Coveralls:** Wearing coveralls is recommended if there is a chance that the user's pants or shirt could become wet with pesticide. Coveralls can be of cloth or the disposable type. Some disposable coveralls can be worn several times and may last for several months before being disposed of.

**Rain Suit:** Rain suits may be necessary while spraying trees or while treating areas outside where there is a risk that wind direction may change and blow spray onto the user.

**Waterproof Hat:** A waterproof, large brimmed hat should be worn if it is necessary to protect the user's hair and face from spray.

**Goggles:** Protective goggles should be worn if there is a chance pesticide dust or spray mist may get into the user's eyes.



**Respirator:** Users should wear respirators to protect their lungs if the label precaution states "avoid inhalation" or if there is a risk that pesticide vapours or dusts could be inhaled. The most common respirator is a half-face cartridge type, which covers the nose and mouth. Chemicals are filtered out when air is inhaled through an organic vapour cartridge attached to the face mask. Cartridges are replaced at regular intervals and should be stored in sealed plastic bags when not in use. Respirators come with instructions on how to make sure they fit the wearer's face (or check with staff of a safety supply store) and how to maintain the equipment. These instructions should be followed carefully.

**Note:** A dust mask is not a suitable alternative to a respirator. A dust mask can protect the lungs from non-toxic dust but not from chemical insecticide dusts, liquid mists or liquid sprays that release toxic vapours.

# Mixing Pesticides

## Ready-to-Use Pesticides

To avoid the need to mix pesticides, customers should be encouraged to purchase ready-to-use pesticides when possible. Ready-to-use products may be best when customers:

- have a pest problem that is likely to occur infrequently or that involves only a small area of application
- are not familiar with the use or handling of concentrated pesticides
- cannot calculate how to mix the concentrated pesticide to get the proper application concentration
- do not understand how a compressed-air sprayer works if it is required for application
- do not know how to calibrate the application equipment, such as measure and adjust its output, if it is required for application
  do not have a safe storage area for concentrated pesticides

**Ready-to-Use Products**

These products are pre-mixed and ready-to-use directly from the container. The ready-to-use products may come in small (500 ml) or large (4 L) containers. They come in a variety of formulations, such as bait pellets, liquids, granules, or dusts. They are usually packaged in applicator containers, such as hand-sprayers, aerosol cans or containers with a dust applicator top. Products are generally less toxic than pesticides that require mixing because they are already diluted for use.

# Pesticide Concentrates

Pesticide products sold in concentrated form are meant to be mixed with water to the correct dilution. It is essential to follow recommended mixing procedures because:

- pesticide concentrates are generally more toxic than diluted sprays
- improper handling of concentrated pesticides can result in poisoning if skin or eyes are contaminated or a pesticide is inhaled into the lungs
- pesticides spilled on the ground contaminate the environment
- the correct dilution is required to ensure effectiveness
- incorrect dilutions can burn plants or cause other damage

## Mixing Precautions

**Mixing Area:** Mix in an area that is well ventilated, well lit and a safe area in which to work. No other people (especially children), or pets, should be allowed near the mixing area.

**Check Labels:** Mix only the recommended amount of pesticide as described on the label. Too much or too little in the mix can cause undesirable results, such as leaf damage to plants or failure to control.

**Separate Pesticides:** Only one product at a time should be mixed in a container for application. If two products are needed, they should be applied separately, unless the products are clearly labelled for joint application, such as dormant oil and lime sulphur.

**Wear Protective Clothing:** See Protective Clothing and Equipment (pg. 33).

**Handle Packages Carefully:**

- Use scissors or a sharp knife to cut open paper bags carefully—do not rip them open.
- Hold all pesticides and containers below eye level while handling to prevent pesticide from accidentally being splashed into the eyes.
- Be careful not to spill or splash liquids, or to create dust, when mixing.

**Protect the Water Supply:** It is essential to avoid contaminating the water supply when putting water into the spray tank. For example, do not push the end of a water hose into the spray tank where it will contact the spray mix. Instead, fill a clean container with water and then pour the water into the spray tank.

**Measure Accurately:** Use measuring spoons and measuring cups for accurate measurement. These measuring tools must be used for pesticide only, never as cooking or eating utensils. They should be labelled "Poison" or "Pesticides Only." A good place to keep these utensils is in the pesticide storage area.

**Note:** Pesticide vendors should sell suitable measuring utensils in the pesticide display area.

**Mix Correctly:** Concentrated pesticides must be evenly mixed with water in the correct proportion before application (see Calculating How Much Pesticide to Buy, pg. 52). The treatment could be spotty if the pesticide is allowed to settle in the spray tank, as might happen if the concentrate is put into the sprayer before adding water.

Correct mixing technique involves four steps:

1. Pour water into tank to half-full level.
2. Use measuring tools to measure out the correct amount of concentrate and put it in the tank.
3. Pour in the remaining amount of water.
4. Close tank, then shake tank to make sure mixing is complete.

**Rinse Containers:** Rinse empty liquid pesticide containers with a small amount of water and put the rinse water into the spray tank.

# Applying Pesticides

## General Precautions

**Do Not Eat, Drink or Smoke:** The user must not eat, drink, or smoke when applying pesticides because pesticide on the skin or clothing may accidentally be consumed or inhaled.

**Spill Response:** If a pesticide is spilled on the user, the user should immediately stop, remove contaminated clothing, wash, and put on clean protective clothing before cleaning up the spill.

### Before Application

To prepare a treatment area **indoors:**

- remove toys, clothes and books or magazines
- in kitchens, remove dishes and food, or place them in closed cupboards that are not being treated
- remove or cover aquariums and turn off air pumps
- keep people and pets out of the area

To prepare a treatment area before applying pesticides **outdoors:**

- remove or cover toys, lawn chairs and fish ponds
- keep people and pets out of the area

## *During Application*

While pesticides are being applied, the applicator must take into account:

**Wind:** Spraying outdoors should be done when there is little or no wind. Winds will blow pesticides off target, giving poor results as well as risking contamination of non-target areas.

**Drift:** This is the movement of very small spray or dust particles and must be prevented or reduced as much as possible. For example, where herbicides are used near desirable plants, even a tiny amount of herbicide drift can injury or kill the plants. It can also become a critical issue if pesticide drifts onto a neighbour's property.

To prevent or minimize drift:

- use a coarse spray of large water droplets rather than a fine spray
- apply the pesticide close to the target
- apply the pesticide when there is no wind
- apply when air temperatures are below 30°C
- use granular instead of dust formulations

**Rain:** Do not apply a pesticide just before, during or after a rainfall. The pesticide may be diluted or washed off, giving poor results, and possibly contaminating non-target areas.

**Temperature:** Pesticides should be applied when temperatures are moderate. High temperatures (above 30°C) can result in excessive release of pesticide vapours and also increase the risk of plant injury from some pesticides. Low temperatures (below 10°C) may also prevent the pesticide from working as it should.

**Timing:** Follow label instructions, if any, on the best timing of the pesticide application. How effective a treatment will be can depend on the growth stage of the pest. For example, a herbicide may kill weed seedlings but not provide satisfactory control of older plants. Also, some herbicides are only effective while weeds are actively growing and will not work on mature plants.

**Non-Target Organisms:** Avoid killing beneficial insects and other non-target living organisms by limiting the pesticide application to only those plants or areas that require treatment. For example, do not use up excess pesticide by spraying more area than was originally planned to be treated. In some cases it may be necessary to adjust the timing of pesticide applications. For example, to protect honeybees, insecticides should only be applied when fruit trees or other plants are not in bloom.

## *After Application*

**Clean up:** Clean-up procedures include washing hands and face with soap and water. The user should shower if there is any body contact with the pesticide. Contaminated clothing should be removed and washed separately from other laundry.

**Observe Re-Entry Times:** Follow any instructions about entering treated areas provided on the label. If no instructions are given on the label, then the following precautions are recommended:

After **indoor** treatments:

- People should not be allowed to enter the treatment area until the pesticide is dry. Wait at least 6 hours before re-entry—the longer the better.
- Pregnant women, new-born babies and people with breathing problems should not enter the treatment area for 12-24 hours.
- The area should be ventilated before re-entry by opening doors and windows and turning on fans to get a complete change of air.

After **outdoor** treatments:

- The treatment area should not be entered until the area is dry. A 24-hour waiting period is recommended.
- If it is necessary to re-enter the area during this time, proper safety protection for hands and feet should be worn (for example, rubber boots and gloves).

**Note: Both indoor and outdoor re-entry times should be viewed as a minimum.** This is because standardized re-entry times have so far not been developed using scientific data on pesticide concentrations in air. In general, the longer any treated area can be ventilated before people re-enter it, the better.

**Observe 'Days to Harvest':** After a pesticide is applied to fruits, vegetables or other edible plants, the crop should not be harvested until after the required waiting period, usually stated on labels as "days to harvest." If harvested too soon after applying pesticides, food crops can contain unacceptably high levels of pesticide residues. The minimum number of days that should pass between the time a pesticide is applied and when the crop is harvested depends on the pesticide and the type of plant. Some pesticides are safe enough to be used up until the day of harvest, others are so persistent that several months are required before produce can be harvested. Pesticide labels list the days to harvest for each type of produce as approved by Health Canada.

# Protecting the Environment

There are several ways that pesticides can cause environmental damage. Dispensers should know what these harmful effects are and how to prevent them. It is the user's legal responsibility to ensure that they do not harm the environment. The dispenser must try to make sure that customer knows enough about handling pesticides correctly to avoid causing environmental damage.

## Possible Harmful Effects

The greatest potential for environmental damage from pesticide use lies in the risk of harming non-target, living organisms, including:

**Pets and Wildlife:** Many pesticides, particularly insecticides, rodenticides, slug baits, and wood preservatives are highly toxic to pets and wildlife. Always check labels for warnings about effects on wildlife. As a rule, pesticides that are toxic to humans are also toxic to wildlife such as birds, racoons, and squirrels. Pesticides with the poison symbol (skull-and-crossbones) on the label are of particular concern.

**Fish:** Some pesticides are highly toxic to fish and other aquatic life. Pay attention to all label warnings.

**Beneficial Organisms:** Since naturally occurring beneficial organisms provide most of the control of pests in the environment, it is important to protect them in order to prevent pest problems. For example, most insecticides are toxic to bees as well as to predatory insects, such as lady beetles, lacewings, ground beetles, and parasitic wasps. Miticides and some fungicides are toxic to beneficial predator mites.

**Desirable Plants:** Most herbicides will kill desirable plants if accidentally applied to them. Some insecticides will also damage plants if mixed or used incorrectly.

## Preventing Environmental Damage

The best way to avoid damaging the environment with pesticides is to use non-chemical controls wherever possible (see Section I of this manual). If pesticides are necessary, the first choice should be the lowest toxicity or least persistent product. Other ways users can help to reduce the risk of environmental damage include:

**Minimize Drift:** Pesticide sprays should not be allowed to drift outside the desired treatment area. Do not spray on windy days and do not allow sprays to drift onto a neighbour's property. Spot sprays, to target plants only, should be used instead of broadcast sprays wherever possible.

**Prevent Water Contamination:** Leave an untreated strip or buffer zone around water including ponds, streams and wells. Pesticide sprays and runoff must not be used in a way that contaminates groundwater, ponds, steams, or marine areas. Unwanted pesticides and spray mixtures must not be poured into household or municipal drains.

**Prevent Animal Poisoning:** Pets and wildlife should be kept out of treated areas. Broadcast sprays and soil drenches of toxic insecticides should not be used on plants or areas where birds or other animals are likely to feed after treatment. Granular formulations of pesticides are particularly hazardous to birds. Rodenticides and slug bait must not be placed where they are accessible to pets or wild animals.

**Protect Beneficial Insects:** To protect beneficial insects, use insecticides that are the most selective, meaning that their effect is limited to certain group of insects. For example, products containing *Bacillus thuringiensis* only affect caterpillars, but not other insects. Use short-lived insecticides such as those containing soaps and pyrethrins.

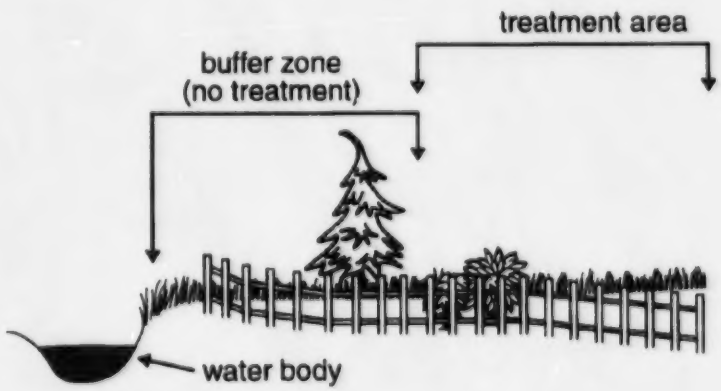
**Protect Desirable Plants:** Herbicide sprays and vapours must not be allowed to drift onto desirable plants. For example, do not use non-selective herbicides, such as those containing glyphosate, on lawn weeds as they will also kill the turfgrass. Soil sterilant herbicides should not be applied near trees, shrubs, or garden areas.

## *Buffer Zones For Sensitive Areas*

Pesticides can be particularly damaging if applied too close to sensitive areas, such as desirable plants, water ditches, ponds, streams, or lakes. To avoid contaminating such areas, applicators should leave a "buffer zone" between the treatment area and the sensitive areas. A buffer zone is an area of land between the sensitive area and the treatment area where pesticides are not applied. This zone must be wide enough to ensure that any overspray, pesticide drift, or runoff could not cross this zone and reach the sensitive areas. The following are examples of buffer zone recommendations for most pesticides used by home and garden customers:

**One Metre Around Gardens:** A buffer zone **at least** one metre wide should be used to protect ornamental beds and gardens from herbicides, or to protect vegetables, fruits, and other edible plants from insecticides being used on nearby ornamentals. Leave greater distances if a breeze is blowing toward the sensitive area (better yet, wait until there is no wind).

**Drip Line Plus One Metre:** Granular herbicides and granular herbicides mixed with fertilizers should be applied no closer than one metre out from the drip line of trees. The drip line is the outer edge of the canopy of leaves on a tree, where water drops from the foliage. This is where the tree usually has many roots and where herbicides would be most damaging to the tree.



**Two Times Tree Height:** Soil sterilants should not be applied within a distance equal to two times the height of a tree, measured from the base of the tree.

This is because tree roots can extend long distances. For instance, if a tree is 10 metres high, then the soil sterilant should not be applied within 20 metres (2x10 metres) of the base of the trunk.

**10 Metres From Water:** Pesticides should not be applied near ponds, lakes, streams or other bodies of water. A buffer zone of at least 10 metres should be kept between the margin of the water body and the edge of the treatment area.

# Pesticide Disposal

## Empty Containers

**Legal Requirements:** Domestic pesticide containers that have been thoroughly drained can be placed in an outdoor household garbage can for disposal with garbage sent to a municipal landfill site.

For containers that held concentrated pesticides, it is recommended that the user rinse the empty container with water and pour the rinse material into the spray tank when mixing the spray solution. The rinsed container can then be disposed of in the garbage.

**Note:** Paper bags or cardboard packaging containers must not be burned as the burning bags or cardboard will release pesticide fumes. No goods or other items should be stored in used containers and the containers should not be re-used for any purpose.

## Waste Pesticides

The long-term solution to the problem of disposing of surplus pesticides is not to accumulate excess pesticides in the first place. Customers should be encouraged to use alternatives to pesticides or to buy only small amounts of pesticides that can be used up in a single season.

Unwanted pesticides must not be poured down the drain, into the sewer, or into any water bearing body such as a ditch, stream, or lake.

Under new legislation, industry is required to establish and fund a system for collecting household hazardous waste throughout BC. Unwanted or waste domestic pesticide products that have a poison symbol (skull-and-crossbones) on the label can be taken to industry operated collection facilities in most major population centres across BC. These are referred to as Consumer Product Stewardship Program Collection Depots. There is no charge to drop off these pesticides. Such unwanted pesticides must be safely stored until they can be taken to the depot. Pesticide vendors must provide their customers with information on the location of these depots on request.

# *Study Questions: Chapter 3 - Pesticide Handling Guidelines*

*Answers are given in the back of this manual.*

1. Which of the following describes safe storage conditions for pesticides around homes?
   a) pesticides should be kept in the basement.
   b) leaking pesticide containers should be replaced with resealable containers such as pop bottles.
   c) the storage area should be dry and protected from extremes in temperature.
   d) the fire department must be notified of the presence of Domestic pesticides at a residence.
   e) (c) and (d)
   f) (b) and (c)

2. Why should pesticide vendor storage areas be inspected often?

3. Which is the recommended list of items for a pesticide spill kit?
   a) kitty litter, broom and dustpan, and plastic bags.
   b) paper towels, broom and dustpan, plastic bucket with lid, and sand.
   c) kitty litter, broom and dustpan, plastic bucket with lid, and decontamination materials.
   d) kitty litter, shovel, dustpan, garbage can, and emergency numbers.

4. Which of the following are precautions to ensure safe transport of pesticides?
   a) pesticides should be placed on the back seat of the vehicle, away from the driver.
   b) pesticides should be secured so they cannot tip over and break during transport.
   c) pesticide containers must be properly sealed before being placed in bags with food or clothing.
   d) if pesticides are being transported in a truck, they should be kept on the floor of the cab to ensure they do not tip over.
   e) (b) and (d)
   f) (a) and (d)

5. Are leather gloves and a dust mask suitable protection for someone applying pesticides? Why or why not?

6. Following recommended mixing procedure for pesticide concentrates is important because:
   a) improper handling of concentrates can result in poisoning.
   b) all pesticides are sold as concentrates.
   c) storing concentrates around the home is not safe.
   d) spilled pesticides contaminate the environment.
   e) (a) and (c)
   f) (a) and (d)

7. Precautions for mixing pesticides include:
    a) seal off the mixing area from the rest of the building.
    b) if two pesticides are needed, mix them together so two applications are not required.
    c) cut open paper bags instead of ripping them open.
    d) rinse empty containers and dispose of the rinse water at a landfill.

8. What type of tools should be used for measuring pesticides? Where should they be kept?

9. When preparing an indoor area for treatment, the applicator should:
    a) remove furniture and wall coverings.
    b) remove toys, clothes and books.
    c) keep people and pets out of the area.
    d) seal off the area from any air currents that may carry the pesticide.
    e) (b) and (d)
    f) (b) and (c)

10. Why is wind a consideration during pesticide application?

11. Why is it important to observe the days to harvest required for a specific pesticide and crop? Where can this information be found?

12. How can pesticide use potentially damage the environment?

13. List ways an applicator can reduce the risk of pesticide damage to the environment.

14. A one-metre buffer zone from the dripline of a tree is recommended when applying:
    a) any pesticide near a water body.
    b) any pesticide near ornamental beds or gardens.
    c) granular herbicides or herbicide-fertilizer mixtures near trees.
    d) soil sterilants near trees.

CHAPTER 4

# EQUIPMENT, APPLICATION AND PESTICIDE USE CALCULATIONS

## Learning Objectives

When you have completed this chapter, you should be able to:

1. *Describe the different types of pesticide application equipment, including how they work and where they should be used.*
2. *Explain why it is important to maintain equipment and how to do it.*
3. *Explain the terms describing application rates found on pesticide labels.*
4. *Determine the amount of a pesticide needed for a job, using ratios and metric calculations.*
5. *Help customers with area and mixing calculations and give them tips for uniformly applying pesticides.*

## Introduction

It is important for anyone applying pesticides to:

- use the most appropriate equipment for the job
- know how to use the equipment correctly
- know how to calculate the quantity of pesticide required

The dispenser can help customers by providing them with information outlined in this chapter.

## Types of Application Equipment

When choosing equipment, make certain that it will deliver the pesticide in a manner consistent with the information on the label and with safety considerations. For example, high tree spraying should be done with high volume equipment, not a hand-held trigger sprayer. Also, while a compressed-air sprayer may be used outdoors, it is risky to use indoors as it is easy for unskilled applicators to apply too much pesticide. The dispenser should be able to demonstrate to the purchaser how the equipment works. The following list describes the equipment that is likely to be used for Domestic pesticides.

## Compressed-Air Sprayers

Compressed-air sprayers use compressed air to force a liquid spray out of a nozzle at the end of an application wand. These sprayers are mostly used to treat pests outdoors on lawns, gardens, ornamentals, and trees. If used indoors the user must take great care not to apply too much pesticide. Surfaces should be just covered with a fine mist, not a wet or dripping coating. Two types of air sprayers are shown here.

Hand held compressed-air sprayers have a capacity of 4 L to 10 L. These sprayers are for spot treatments or broadcast treatments to small areas. The unit is placed on the ground and pumped by hand to compress the air inside the tank. When pressurized, the tank is carried in one hand while the wand with the nozzle is carried in the other hand. The rate of pesticide application depends on the air pressure in the tank, how fast the user is walking, and the nozzle type or setting. For example, high pressure forces the pesticide out faster than low pressure.

The correct technique for using a compressed-air sprayer is to apply the spray at a constant pressure and at a regular speed. The sprayer should be regularly pumped up to maintain a relatively constant pressure that produces a fine spray, not a mist. If the spray is maintained at a constant pressure, the user can lower the application rate by speeding up the walking pace. Conversely, walking slower will increase the application rate.

To achieve even spray coverage over an area, the user should:

- walk at a regular pace
- move the wand sideways in a back and forth motion at a constant speed
- keep the nozzle height about 30 cm above the ground while using a wide angle or fan spray pattern
- overlap the edges of the spray pattern for good coverage
- apply the spray within arm's reach and not over-reach with the wand
- walk in one direction in a straight line until reaching the end of the strip, then turn around and spray the next strip
- treat the entire area using this back-and-forth pattern

If customer's have no experience with this type of sprayer, they should be advised to practice, using only water in the tank, until they feel confident they can maintain an even application pattern.

## Hose-End Sprayer

With this type of system, a container with a nozzle and a hose fitting is filled with concentrated liquid pesticide. This is screwed onto the end of a hose and, when the water is turned on, the flow mixes the concentrated pesticide with the water to produce a pesticide spray. These sprayers are only used for treating outdoor areas such as lawns, gardens, and ornamentals. The key disadvantage of

this type of sprayer is that it is hard to apply the pesticide at the correct rate. The rate of delivery varies with changes in water pressure and any clogging of the nozzle makes the system even more inaccurate. Calculating the correct amount of a pesticide concentrate to add to a hose-end container is very difficult.

## Trigger Pump or "Squirt Gun" Sprayer

These are small, hand-held sprayers, which usually contain less than 4 litres of ready-to-use pesticide. The user sprays the pesticide by hand squeezing a button or lever that is usually attached to the top of the container. Larger containers are designed to be carried in one hand, while, in the other hand, the user squeezes a spraying nozzle attached to the container by a length of tubing. These sprayers are used for small areas and for spot treatments indoors and outdoors.

## Pressurized Container (Aerosol)

These small, non-reusable hand-held pressurized containers hold ready-to-use pesticides in quantities of less than 1 L. Aerosol sprays are not meant to fill the air with vapour, only to apply a layer of fine droplets to surfaces. They are used to treat small, localized pest problems, both indoors and outdoors. Aerosols must be applied carefully to avoid reflecting the pesticide back to the user, which can happen when a high pressure spray hits a solid surface.

## Dust Applicator

Dust applicators may be designed as part of the pesticide container, or they may be a separate piece of equipment. Container designs include squeezable plastic cylinders with shaker holes in the lid or a simple nozzle on top. Specialized dust applicators range from large dusters, with bulb pumps, to small, squeeze dusters used for dusting in crevices and holes.

**Note:** Vendors selling dusts for indoor use should stock dust applicators.

## Spreaders

Spreaders are large pieces of equipment used outdoors to apply granular products (usually herbicide/fertilizer combinations used on lawns). There are drop action spreaders and rotary spreaders. In drop spreaders, the granules fall out of a hopper, through slots or holes, as the spreader is pushed along. Rotary spreaders fling the granules from a rotating wheel under the hopper as they are pushed. With a rotary spreader, consecutive passes should partially overlap in a criss-cross pattern to obtain even coverage. Care must be taken to ensure the granules are not thrown outside the intended treatment area as lawn herbicides will damage or kill shrubs and bedding plants.

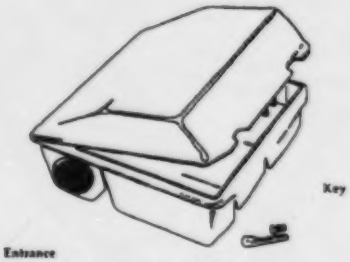
The material in the spreader must fall out at a regular rate. The spreader should be clean to prevent clogging of the holes. Some spreaders should only be opened while walking at a regular rate. Opening this type of spreader before starting to walk can cause an excess amount of pesticide to fall out on the spot, which may burn or damage the turf. It is important to maintain a regular walking pace to ensure a uniform application rate.

## Special Equipment

Bait stations and other special equipment are used indoors or outdoors in specialized situations. For example, rodenticide baits should only be used in child-proof bait stations. The bait is placed inside and the bait station is closed and secured to keep children and pets from getting to the rodenticide.

**Note:** Vendors selling rodenticide baits should stock tamper-proof bait stations and strongly advise the customer.

Bait stations are also used for metaldehyde slug bait to prevents pets and wild animals from eating the bait, which is highly attractive to them. The bait stations can be home-made or purchased.



An Example of a Bait Station

## Equipment Maintenance

It is important to maintain the application equipment to ensure that pesticides are applied effectively. Always make sure that the equipment is not clogged, leaking or otherwise poorly maintained, which can give uneven results as well as present a safety hazard.

The person applying pesticides should do the following:

**Check Equipment:** Before use, check the nozzle, pump, and other parts to make sure they are working properly and are not leaking or clogged.

**Clean Equipment:** After use, the equipment should be cleaned. Thorough cleaning prevents corrosion and build-up of caked or gummy pesticide residues. Clean the equipment in an isolated area away from people and well away from streams, ponds, drains, or ditches to ensure pesticide residues are not carried into water.

**Note:** It is advisable to keep a separate sprayer, designated for herbicides only, and not to use herbicides in the same equipment used for insecticides or fungicides. This is because even a trace of some herbicides can damage sensitive plants. Washing the equipment thoroughly is always advised, but is not a guarantee that there are no traces of herbicide present.

## Application Rate

The application rate is the amount of pesticide applied to a unit area. The rate(s) and method that will give the desired results are stated on the pesticide label.

The application rate depends on:

- how much of the active ingredient is in the mixture (the concentration)
- how much of the mixed pesticide is applied to the target site or plants

Applying either too much or too little of the pesticide to the target site can cause problems.

**Over Application:** Too much pesticide can be applied to a site if there is more concentrate used in the mix than there should be (it is not diluted correctly), or if too much of the mixture is applied in one place. Over applying a pesticide may:

- damage the area treated
- damage or kill plants and other non-target organisms
- increase hazard to the applicator
- produce excess residue on harvested produce

Using more pesticide than stated on the label will also cost the applicator more money.

**Under Application:** Using less pesticide than specified on the label, by using incorrect measuring or mixing or by poor application techniques, may:

- make re-treatment necessary
- allow a pesticide resistant pest population to develop from pests that were not killed by the low rate

The label usually gives specific information on how to mix the pesticide to the correct concentration. For example, mix 30 ml of pesticide in 5 L of water and apply to 100 $m^2$. The label may also describe how to apply the material to the target.

## *Application Rate Terminology*

**Spray to Wet Surface:** When the label says to "spray to wet surfaces," such as carpets, baseboards, or plant leaves, this means that enough pesticide is applied to cause the surface to be damp or wet to the touch, but not to cause the pesticide to run, drip, or puddle.

**Spray to Drip:** A label may indicate a pesticide is to be "sprayed to drip" or "spray to run off." This means that the spray droplets run together and start to drip off the plants. Spraying should be stopped just as the pesticide first begins to drip off the plants.

**Light Dusting:** Dusts should be applied in a very fine layer. A "light dusting" means just enough to barely see a dusty effect. This does not mean the dust is thick enough to obscure the surface. Thick dust repels insects and when applied to plants, also stops sunlight from the reaching leaves.

**Broadcast Treatment:** When a pesticide is applied evenly over an entire area it is termed a "broadcast treatment." An example is treating an entire lawn for a broad-leaved weed infestation using a selective herbicide.

**Spot Treatment:** A "spot treatment" is just what it sounds like. The pesticide is applied to small, specific areas, such as individual plants or areas less than 15-20 $cm^2$ in size. For example, a lawn with a light infestation of broad-leaved weeds could be spot-treated with herbicides. The herbicides would be applied just to the individual weeds rather than treating the whole lawn.

**When Customers Cannot Handle the Pest Problem**

Some customers do not have the expertise to deal with pest control problems. This may be especially true if the pest population may cause a health problem (for example, a large rodent infestation in a home or serious structural damage from termites). Customers may not know enough about the pest biology, inspection methods, application methods or safety considerations. Some customers may not be able to read the label well enough to know how to use the pesticide or may not be physically able to carry out the work. In such cases, the dispenser should advise customers that it would be best for them to use a pest control service company. These companies are listed under "Pest Control" in the Yellow Pages of the telephone book. A policy for making such recommendations to customers should be developed and discussed with staff at each pesticide vendor outlet.

# Pesticide Use Calculations

## Introduction

Dust or granular pesticides, and many liquid pesticides, are sold in formulations that are ready to use without further mixing. It is relatively easy to calculate how much to buy or use of such products. Pesticide concentrates, which must be diluted with water before use, require an extra calculation step. Calculations for diluting concentrates are described later in this section.

Pesticide dispensers should be able to assist customers with two types of pesticide use calculations.

You should be able to determine:

- how much pesticide the customer should buy
- how much pesticide concentrate to add to a spray tank to make a certain quantity of a spray mixture

These calculations can only be made after it has been decided which pesticide will be used. This is because you must read the label to find out the application rate given for the specific pest, plants or site to be treated. The calculations required for these questions generally involve metric units and ratios. Dispensers should be familiar with both of these.

### Metric Units

Label rates use metric measures for length, area, weight and volume. The dispenser should be familiar with the following metric units:

- length is measured in metres (m)
- area is measured in square metres ($m^2$)
- weight is measured in grams (g) or kilograms (kg)
- volume is measured in litres (L)

Dispensers must know the following relationships:

- 1 kg = 1,000 grams (g)
- 1 L = 1,000 millilitres (ml)

Dispensers should be able to convert from Imperial measures to Metric measures.

**Table 3: Conversion from Imperial to Metric Measures**

| Imperial Measure | Times | Conversion Factor | | Metric Measure |
|---|---|---|---|---|
| feet | X | 0.305 | = | metres (m) |
| yards | X | 0.91 | = | metres (m) |
| square feet | X | 0.093 | = | square metres ($m^2$) |
| teaspoon | X | 5 | = | millilitres (ml) |
| tablespoon | X | 15 | = | millilitres (ml) |

## *Ratio Calculations*

Most pesticide use calculations involve ratios. For example, to determine how much pesticide to add to a spray tank or how much to apply to a specific area.

A simple method of solving a ratio problem is to use cross-multiplication.

**Ratio Calculations**

Ratio calculations are easy when you understand the steps:

**Example 1: General Example**

6 apples cost $1.20.
How much do 20 apples cost?

**Step 1. Set up the ratio:**

Set up the ratio with the unknown factor on the top. This is the shortest way to do the calculation.

$\frac{\$\ ?}{20 \text{ apples}} = \frac{\$1.20}{6 \text{ apples}}$

Think of this as: "$ ? is related to 20 apples as $1.20 is related to 6 apples"

**Step 2. Cross-multiply:**

$\frac{\$ ?}{20} = \frac{\$1.20}{6}$

$\$ ? = \frac{\$1.20 \times 20}{6}$ (read this as: "multiply $1.20 by 20, then divide that result by 6")

$\$? = \$4.00$

The cost of 20 apples = $4.00

**Example 2: Using Ratios to Calculate Amount of Pesticide Required**

A label says to mix 250 ml of liquid pesticide concentrate per 1 L of spray. How much product do you add to a spray tank to make 1.5 L of spray?

**Hint:** In this case the unknown factor is ? ml needed to make a 1.5 L quantity. The known ratio is the ratio of 250 ml to 1 L as stated on the label

The equation for cross-multiplying is: $\frac{? \text{ ml}}{1.5 \text{ L}} = \frac{250 \text{ ml}}{1 \text{ L}}$ (Remember: 1 L = 1000 ml)

? ml x 1000 ml = 250 ml x 1500 ml

$? \text{ ml} = \frac{250 \times 1500}{1000}$

? ml = 375 ml of product is needed to make 1.5 L of spray

Most calculations in this section will done by the ratio method. Not all steps were shown in calculations. Anyone having difficulty with the math in this section should seek assistance from an instructor, tutor, or someone who has an applicator certificate.

## *Calculating How Much Pesticide to Buy*

A common question asked by customers is how much pesticide do they need to buy for a pest problem. To answer this question, the dispenser needs to know:

- the number of plants to be treated
- the area to be treated
- the number of treatments required per year

If the customer has some information on the size of the area to be treated, the dispenser should be able to help calculate how much pesticide is needed.

If the customer does not have this information then it won't be possible to calculate the amount of pesticide required. In this case, it is best to recommend the smallest size container, preferably of a ready-to-use product, rather than a concentrate that requires mixing.

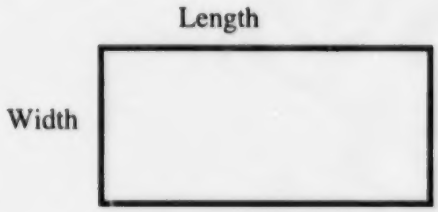
There are two ways that pesticide labels describe how much pesticide to use. They are "**amount per area**" (apply 250 ml per 100 $m^2$ of lawn) and "**spray to wet**" (use 50 ml in 4 L of spray). Examples are given for calculating how much pesticide is needed for each type of treatment.

## Area of a Treatment Site

The first calculation that may be required is the size of the treatment area. By knowing how to calculate the size of a square, rectangle or triangle, the size of any treatment area can be calculated.

A very accurate way to measure the area is by using a tape measure. Another practical way to measure is by counting the number of paces it takes to walk the side of the area. On average, 1 long pace usually equals 1 m (this is easily checked against a measuring tape before pacing off the distance).

**Area of square or rectangle = length X width**
Example: A lawn is 10 m long and 6 m wide. What is the area of the lawn?

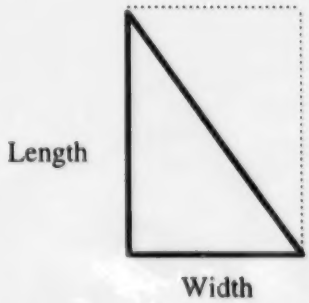



Area = length X width
Area = 10 m X 6 m
Area = 60 $m^2$

Example: A lawn is 10 m long and 6 m wide. What is the area of the lawn?

**Area of triangle** = $\frac{\text{length X width}}{2}$

Example: The length of the triangle-shaped area is 4 m and the width is 3m. What is the area of the triangle?




Area = $\frac{\text{length X width}}{2}$

Area = $\frac{4\text{ m X }3\text{ m}}{2}$

Area = $\frac{12\text{ m}^2}{2} = 6\text{ m}^2$

## *Calculations for Ready-to-Use Pesticides*

For products sold already mixed to the correct concentration, such as ready-to-use sprays and granular or dust products, it is simple to calculate the amount required.

**Amount per Area:** Some pesticide labels state how much pesticide should be applied per area. For example, 250 ml per 100 $m^2$ for a liquid spray or 2.5 kg per 100 $m^2$ for a granular product. If the customer knows the area to be treated, calculating the amount to buy is relatively easy using a simple ratio calculation.

### How Much Pesticide To Buy?

**Example 1. Liquid Spray**
The treatment area is 400 $m^2$. The application rate is 250 ml per 100 $m^2$. What is the total amount of pesticide required to treat 400 $m^2$?

$$\frac{? \text{ ml}}{400 \text{ m}^2} = \frac{250 \text{ ml}}{100 \text{ m}^2}$$

$$? \text{ ml} = \frac{250 \text{ ml} \times 400 \text{ m}^2}{100 \text{ m}^2}$$

$$? \text{ ml} = 1{,}000 \text{ ml}$$

1,000 ml of pesticide is needed to treat 400 $m^2$. (Note: 1,000 ml equals 1 L).
The customer would need one, 1 L container or two, 0.5 L containers.

**Example 2. Granular or Dust Application**
The label says to apply 2.5 kg per 100 $m^2$ The treatment area is 50 $m^2$ in size. What is the total amount of product required to treat the entire area?

$$\frac{? \text{ kg}}{50 \text{ m}^2} = \frac{2.5 \text{ kg}}{100 \text{ m}^2}$$

$$? \text{ kg} = \frac{2.5 \text{ kg} \times 50 \text{ m}^2}{100 \text{ m}^2}$$

$$? \text{ kg} = 1.25 \text{ kg}$$

1.25 kg of pesticide is needed to treat 50 $m^2$.

**Note:** You must look at the "net contents" size of the pesticide containers. If the net contents of the pesticide container is 0.5 kg, your customer would need 3 containers (0.5 + 0.5 + 0.5 = 1.5 kg). If the customer wants to make two applications in a season twice as many containers are needed.

**"Spray to Wet" Surface:** Some product labels say to spray individual plants, trees or structures. They might state "spray lightly" or "to run off," but may not give the expected area a certain amount of pesticide will cover. These instructions are on ready-to-use products, as well as on some products that must be diluted before use. How much to buy then depends on the number of plants or the area to be treated. This requires some experience and judgement on the part of the dispenser to assist in estimating the amount required.

In general, do not recommend concentrates for relatively small treatments. A customer may find it best to try the ready-to-use option first and to come back for a concentrate product if the ready-to-use product fell far short of covering the treatment area. Most customers have small yards and gardens, therefore, by discouraging them from buying too much pesticide you help them avoid the risks of storing chemicals around their home.

## *Calculations For Pesticide Concentrates*

When a pesticide concentrate is used, it is essential that the customer can calculate the correct amount of concentrate to mix with water in a sprayer.

Most pesticide labels give the application rate in the form of a dilution ratio, such as apply 15 ml per 1 L of water. A few may give the application rate in terms of the amount per area, such as apply 250 ml per 100 $m^2$.

Different calculations are required for these two types of label instructions, as follows:

**Calculating Dilutions:** The label may specify adding a certain amount of pesticide concentrate to make a quantity of spray. The user must calculate how much concentrate should be used to make up the total quantity of spray needed. For example, many garden sprayers hold 4 L, therefore, the following example shows how to calculate the amount of concentrate needed to make 4 L of spray.

### Calculating Dilutions

**Example:**
The label says mix 15 ml in 1 L of water. The spray tank is 4 L in size.
How much concentrate should be added to make 4 L of spray in the tank?

$$? \text{ ml} = \frac{15 \text{ ml} \times 4 \text{ L}}{1 \text{ L}}$$

$$? \text{ ml} = 60 \text{ ml}$$

60 ml of pesticide should be added to make 4 L of spray. Note: there are 15 ml to a tablespoon, so you need:

$$\frac{60 \text{ ml}}{15 \text{ ml per tablespoon}} = 4 \text{ tablespoons}$$

**Calculating Amount Per Area**: If the label says how much pesticide to apply per area, such as 250 ml per 100 $m^2$, you first need to know how much area your sprayer will cover. This is called calibrating the sprayer.

There are several ways to determine the area a sprayer will cover. For small sprayers, the easiest way to do this is to spray out a tankful of plain water to uniformly cover an area. Then measure the area. For example, if you covered an area of 20 x 6 m, your sprayer covers 120 $m^2$.

**Note:** A more detailed method, suitable for any size of sprayer, is given in *A Gardener's Guide To Pest Prevention and Control in the Home and Garden*, produced by the Ministry of Agriculture and Food. Dispensers might want to recommend that a customer buy this book. Copies are available from Crown Publications Inc, 521 Fort St., Victoria (phone 1-800-282-7955), as well as from local bookstores and garden centres.

The following example shows you how to calculate the amount of concentrate to add to a 4 L sprayer that you have determined will cover 120$m^2$:

## Calculating Amount Per Area

**Example:**
The label application rate is 250 ml concentrate per 100 $m^2$. The sprayer coverage is 4 L per 120 $m^2$. How much concentrate must be added to the spray tank to apply to 120 $m^2$?

Hint: In this example the key ratio is the ml of concentrate per $m^2$ since you already know that you will use the entire 4 L of spray to cover the desired area.

This can be calculated using ratios:
? ml concentrate per 120 $m^2$ is equal to 250 ml concentrate per 100 $m^2$.

$$\frac{?\ ml}{120\ m^2} = \frac{250\ ml}{100\ m^2}$$

$$?\ ml = \frac{250\ ml \times 120\ m^2}{100\ m^2}$$

$$?\ ml = 300\ ml$$

The answer is that 300 ml of concentrate should be added to a 4 L spray tank to cover 120 $m^2$.

A few labels give the application rate as the amount of concentrate to mix in a certain quantity of water to cover a given area. For example, the label may say to apply 50 ml of concentrate in 10 L of water to cover 100 $m^2$. In this case the sprayer must be adjusted to apply as close to 10 L of water per 100 $m^2$ as possible. If the sprayer doesn't hold 10 L, then the first calculation is to use a ratio to find out how much area the sprayer should cover at the correct rate.

### How Much Area Will a Sprayer Treat?

**Example:**
The rate should be 10 L of spray per 100 $m^2$. The sprayer holds 4 L. How much area should be covered by a 4 L sprayer at the correct application rate of 10 L per 100 $m^2$?

$$\frac{? \text{ m}^2}{100 \text{ m}^2} = \frac{4 \text{ L}}{10 \text{ L}}$$

$$? \text{ m}^2 = \frac{100 \text{ m}^2 \times 4 \text{ L}}{10 \text{ L}}$$

$$? \text{ m}^2 = 40 \text{ m}^2$$

The 4 L sprayer should be adjusted so that one tankful of spray covers 40 $m^2$. Then work out how much pesticide to add to the 4 L sprayer using a dilution calculation as above.

## *Uniform Application*

It can be difficult to uniformly cover a large area with spray, granules, or dust at the required application rate. A way to check this is to divide up the treatment area into smaller areas (for example, 10 $m^2$). It is important to uniformly cover each 10 $m^2$ area with the right amount of pesticide, before going on to the next 10 $m^2$ area. Measuring out only enough pesticide to treat each 10 $m^2$ section further ensures the correct amount is used.

If a sprayer tank has volume measurements clearly marked on it (usually in 1 L divisions), it is easy to monitor the quantity of spray as it is being used to check that the correct amount is being applied.

## *Adjusting Output of Sprayers or Granular Applicators*

To ensure a pesticide is applied at the correct rate, it may be necessary to adjust the output of the application equipment. For example, it is a good idea to check sprayer adjustments while using plain water in the sprayer until the correct amount is delivered.

If the application equipment is putting on too little or too much pesticide for the area, adjustments can be made as follows:

a) If the output is too low, for example, you want to apply 10 L of pesticide per 100 $m^2$, but actually use up only 6 L to cover 100 $m^2$, then you can:

- move the sprayer or spreader more slowly, by walking slowly, to increase the amount applied
- open the nozzle or release gate to increase the flow of pesticide
- increase the pressure in an compressed air sprayer
- if the equipment cannot be adjusted to increase the rate sufficiently, use one-half the recommended output and treat the area twice

b) If the output is too high (for example, you want to apply 10 L of spray per 100 $m^2$, but instead you need 16 L to cover 100 $m^2$) then you can:

- move the sprayer or spreader more quickly by walking faster
- decrease the air pressure in a compressed air sprayer
- close down the nozzle opening or release gate

# Study Questions: Chapter 4 - Equipment, Application, and Pesticide Use Calculations

*Answers are given in the back of this manual.*

1. Describe the correct technique for using a compressed air sprayer.
2. What is one way to ensure that the material in a granular spreader is applied at a regular rate?
3. Why must pesticide application equipment be cleaned and checked before and after use?
4. What is the main disadvantage of using a hose-end sprayer to apply pesticides?
5. List four problems with over-applying pesticides.
6. Define "broadcast treatment"? What is a "spot treatment"?
7. What is the difference between the application terms "spray to drip" and "spray to wet surface"?
8. A customer wants to treat a lawn that is 12 ft by 18 ft. How many $m^2$ is this?
9. An area to be treated is 8 m long and 7 m wide. During a test of the sprayer, the applicator used 0.5 L of spray to wet the surfaces. The test area was 2 m by 2 m. How much spray would be needed to treat the entire area (8 m x 7 m) at this rate?
10. A pesticide label says to use 15ml of concentrate per L of spray. How much pesticide concentrate would be required for the treatment area in question #9?
11. Another pesticide label says to apply 250 ml of liquid concentrate to 100 $m^2$ of treatment area. How much liquid concentrate would be required to treat the area in question #9?
12. Yet another pesticide label says to apply 1.5 kg per 100 $m^2$. How much of this pesticide would be required for treating the area in question #9?
13. Calculate the total amount of pesticide needed for question #9 if two treatments will be made in one year:
    a) using the pesticide from question #10
    b) using the pesticide from question #11
    c) using the pesticide from question #12
14. Calculate the number of containers required from question #13:
    a) using the total pesticide from #13 (a), if the container size is 80 mL
    b) using the total pesticide from #13 (b), if the container size is 150 mL
    c) using the total pesticide from #13 (c), if the container size is 1 kg
15. A pesticide label says to apply 250 ml per 100 $m^2$, using a compressed air sprayer. A gardener tries the sprayer on a 5 $m^2$ test area, and uses 15 mL of spray. Is the application rate correct? If not, what can the gardener do to change the application rate to comply with the label instructions?

CHAPTER 5

# EMERGENCY RESPONSE

## Learning Objectives

When you have completed this chapter you should be able to:

1. *Know what emergency plans to have in place in the event of a pesticide spill or fire involving pesticides.*
2. *List items that should be included in a pesticide spill kit.*
3. *Describe safe procedures for cleaning up pesticide spills.*
4. *Know what emergency numbers to post, where to call for decontamination information, and who to notify if a pesticide is spilled in the environment.*
5. *Describe first aid for someone who has been exposed to a pesticide.*
6. *Describe what to do in the event of a fire involving stored pesticides.*

## Introduction

Pesticide spills and fires involving pesticides can happen at a vendor site or once pesticides have been bought and taken home. Dispensers must be able to take appropriate measures during an emergency to ensure the safety of themselves, other employees, and customers at the vendor site. Dispensers should also be able to help customers prepare for emergencies involving pesticides at home.

## Pesticide Spills

Pesticide spills jeopardize the safety of people and animals in the area as well as contaminate the environment. Taking prompt action to clean-up and knowing basic first aid for pesticide spills can prevent a minor problem from becoming a serious incident.

### Spill Contingency Plan

It is the responsibility of the pesticide dispenser to prepare a plan for handling spills at the vendor site. The plan should cover all aspects of handling a spill, such as who to notify, location of spill kits and how to deal with the type of pesticides stored at the vendor site and hazards they present. Other

employees should know where the plan is kept, and, if possible, know the plan themselves, in case they have to deal with a spill.

**Evaluate Hazard of Stored Pesticides:** The hazard presented by a spilled product depends on the pesticide. For example, a spill involving low-toxicity insecticidal soap would not require the same reaction as an acutely toxic dimethoate concentrate. Hazard should be evaluated by checking the label of stored pesticides for warnings and poison symbols.

**Post Emergency Numbers:** Emergency telephone numbers for the local police and fire departments, ambulance service, Poison Control Centre and the Provincial Emergence Program number **(1-800-663-3456)** must be readily available, preferably posted beside telephones in the vendor display area or otherwise clearly visible.

## Pesticide Spill Kit

A spill clean-up kit should be located near pesticide storage or display areas. At a minimum, the kit should contain:

**Safety Equipment:** Appropriate personal protective equipment should be available for dealing with a spill, (for example, unlined rubber or plastic gloves, unlined boots, coveralls, and a cartridge respirator suitable for pesticides).

**Absorbent Materials:** For containing and soaking up spills, absorbent material such as kitty litter, sand, vermiculite, or sawdust are required.

**Decontamination Materials:** Soap and bleach should be available for decontaminating the spill site. Do not use bleach unless it is specified on the label or the Material Safety Data Sheet (MSDS) sheet.

**Other Tools:** Clean-up tools include a long handled broom, dustpan, and shovel. Garbage bags and a plastic bucket or garbage pail with lid are required for containing waste.

## Procedures for Handling Spills

It is essential to respond quickly to pesticide spill emergencies and to remove the spilled pesticide as soon as possible. The following steps should be taken:

1. **Isolate Area:** Keep people and animals away from the spill area.

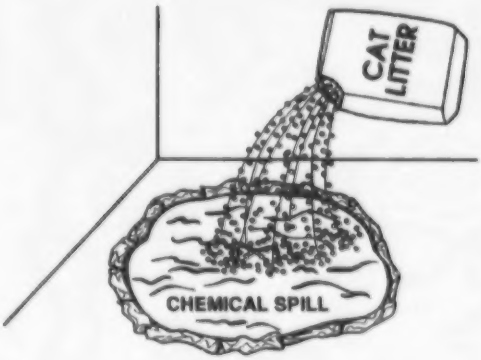
2. **Read Label:** Product labels may contain information on how to respond to a spill and should be consulted first for specific precautions.

3. **Ventilate Area:** If the spill is indoors, ensure there is maximum ventilation by opening all possible windows and doors to prevent build-up of vapours.

4. **Wear Protection:** Put on personal safety equipment as required to keep the pesticide from contacting skin or clothing. At a minimum, wear unlined rubber or plastic gloves, long-

sleeved shirt, long pants, and shoes and socks. Wear a respirator if necessary to prevent inhalation of pesticide vapours.

5. **Containing Liquids:**




   - Put down a barrier to prevent spilled liquids from spreading. This could be sand, paper towels, or any absorbent material immediately available.
   - Place leaking containers inside new plastic containers to prevent additional pesticide from spilling.
   - Soak up liquid pesticides with absorbent materials from the spill kit or other readily available materials.
   - Do not try to wash away spilled pesticides. This will contaminate a greater area, make decontamination more difficult and present a greater risk to the environment due to run off.

6. **Collecting Dusts:**
   - Dusts should be moistened with a fine mist before removal to prevent dust from floating into the air during clean-up.
   - Do not use a vacuum cleaner to collect spilled dust.

7. **Dispose of Waste:** Put the pesticide clean-up materials and pesticide residue into a sealed plastic container. Label the container with the name of the pesticide and PCP Registration number. For proper disposal, a vendor would use the services of a private waste disposal company. A homeowner should take pesticide residue from a container with a toxic warning symbol (skull-and-crossbones) on the label, to the nearest Consumer Product Stewardship Program collection depot. A container with low toxicity pesticide residues can be disposed of with household garbage.

   **Note:** Collected pesticide from the spill may still be good for use and does not require disposal. For example, a granular pesticide spilled onto a dry, hard surface could be collected and used.

8. **Change Clothes/Wash:** After the spill is cleaned up, remove safety equipment, shower, and change clothes if it is possible that they were contaminated during cleanup.

# First Aid For Pesticide Exposure

Take the following steps to assist a person who has been exposed to a pesticide:

1. **Prevent Additional Contamination:** This usually means moving the person away from the spill area, although it may require moving containers of pesticide away from the person. Remove any contaminated clothing. Wash any body areas in contact with the pesticide, using soap and water, as soon as possible.

2. **Check that Victim is Breathing:** Artificial respiration takes precedence over all other first aid procedures.

3. **Get Medical Aid:** Call for medical aid immediately. Provide as much information as possible about the pesticide by keeping the container and label handy. Provide the history of exposure and poisoning symptoms.

4. **Keep Victim at Rest, Warm and Comfortable:** The victim should be kept calm, preferably lying down, until medical help arrives. Continue any first aid treatment.

**Note:** Additional first aid procedures for handling specific types of poisoning resulting from pesticides on skin, in eyes, inhaled or swallowed can be found in the *Handbook for Pesticide Applicators and Dispensers.*

## Decontaminating Spill Sites

Technical information on pesticide clean-up and decontamination may be obtained from CANUTEC, a data bank in Ottawa, operated by Transport Canada. They maintain a 24-hour emergency number (see box). Phone the 24-hour Provincial Emergency Program number and an operator will contact the appropriate staff and notify them of the spill, or obtain assistance as required.

**24-Hour Emergency Numbers**

| | | |
|---|---|---|
| **CANUTEC** | **1-613-996-6666** | **Pesticide clean-up, Decontamination information** |
| **BC Provincial Emergency Program** | **1-800-663-3456** | **Spills in the environment** |

Following are standard procedures for decontamination of:

**Hard Surfaces:** For cement or tile floors, a small amount of soap and water can be used to wash the contaminated area. Remove the wash solution with absorbent material. The washing may have to be repeated for thorough cleaning. The wet material should be placed in a plastic bag, and the bag placed in an outdoor garbage can.

**Soil:** The top 3 - 6 cm of soil should be removed, placed in a plastic bag and disposed of in an outdoor garbage can.

# Fires Involving Pesticides

Fires involving pesticides are hazardous because chemicals can be released as vapours into the air and spread by water used to fight the fire.

## Fire Safety Plan

The pesticide dispenser should have a plan of action ready in the event of a fire where pesticides are stored. This plan should be known to the staff. Safety preparations for fires include:

**Install Fire Extinguisher:** A pesticide storage or display site must be equipped with a fire extinguisher rated for chemical fires.

**Post Emergency Numbers:** A list of emergency telephone numbers for the local police, fire department, and ambulance service should be posted in the vendor display area.

**Notify Fire Department:** It is a legal requirement that the local fire department be notified of the location of any vendor sites that contain pesticides. This is not required for households where pesticides are stored, but if a fire does occur in this situation, the fire department should be informed that pesticides are present.

## Fire Emergency Procedures

**Vacate the Area:** Clear the area of people and animals and evacuate them upwind of the fire.

**Call Fire Department:** The fire department must be called immediately. Make it clear that pesticides are on the property and provide as much information as possible on the specific pesticides involved. If necessary, call police to control traffic, and get medical aid to deal with cases of pesticide exposure.

**Decontaminate Area:** In consultation with fire fighting experts, proceed with decontamination of equipment, protective clothing and land where pesticides have been released.

# Study Questions: Chapter 5 - Emergency Response

*Answers are given in the back of this manual.*

1. Which of the following should be considered in a spill contingency plan?
   (a) warehouse construction materials
   (b) hazard evaluation of each product stored
   (c) emergency telephone numbers
   (d) location of first aid kit and spill clean-up kit
   (e) (b) and (c)
   (f) (b), (c) and (d)

2. Which of the following is NOT a recommended procedure for handling spills?
   (a) read pesticide label
   (b) ventilate area
   (c) wash away as much pesticide as possible
   (d) keep other people and pets out of the area

3. Why should a dispenser check the product label before starting to clean up a pesticide spill?

4. After contamination with a pesticide, what type of surface(s) can be cleaned with soap and water?
   (a) wooden shelving
   (b) concrete floor
   (c) dirt floor
   (d) carpeted floor

5. A co-worker has spilled pesticide on himself and you go to help him. List the four basic first aid steps you should take.

6. What are two major hazards associated with fires involving pesticides?

7. List three safety preparations the vendor should make for fires involving pesticides.

CHAPTER 6

# PESTICIDE USE REMINDERS

## Learning Objectives

When you have completed this chapter, you should be able to:

1. *Correct common misconceptions customers have about pesticides.*
2. *List tips and safety recommendations for mixing and applying pesticides, both indoors and outdoors.*

## Introduction

This chapter provides answers to some frequently asked questions and common misconceptions that customers have about pesticides. Although some of these points have been covered in the previous chapters, they are repeated here to provide a quick reference for dispensers.

## Common Misconceptions

**"Pesticides are the best way to control pests."**

This is false. For many home and garden pests, other types of controls work as well or better than pesticides, and are often cheaper. They also do not have the associated risks of toxicity, residual effects, and harm to non-target organisms. Other methods do not require the user to invest in protective clothing, provide a safe storage area, or dispose of waste products.

**"Pesticides only kill pests."**

Many people do not realize that pesticides work wherever they are applied and will kill more than "pests." For example, customers applying a herbicide they think of as a "weed killer" in their rose garden may not realize that the roses could be killed as well. The same goes for slug baits and rodent baits, which could also kill pets. Insecticides will also kill beneficial insects. It should be made clear to customers that they can kill more than they intend to when they apply pesticides without caution and care.

**"If some pesticide is good, then more is better."**

This is false because using more of a product than indicated on the label may cause leaf damage as well as be harmful to the user, bystanders, pets, and beneficial organisms.

**"Old products should be used at a higher rate."**

People may think this would make up for deterioration of an old pesticide, but it is false. This is because most products have a shelf life of many years if kept at moderate temperatures. Also, if it is has degraded, the product may not have any pesticidal activity. There is usually no way someone can tell by looking at a product whether or not it has degraded. Label rates must be followed. If a product is old, then it might be better to dispose of it and purchase a new container.

## General Problems

**Confusion About Pesticide Products:** Customers often do not know the characteristics of pesticides they are purchasing. For example, they may not know:

- the difference between ready-to-use and concentrated products
- whether a pesticide has a systemic or contact mode of action and what these mean
- whether a herbicide is selective or non-selective and how that affects their pattern of use

As a dispenser, you should be familiar with the various types of pesticides mentioned above, be able to describe products to customers in terms of their actions, and recommend products suited to the customer's situation.

**Plant Problems Mistaken for Pest Damage:** The majority of plants seen in garden diagnostic clinics are suffering from physical problems, not from pest attack. Nutrient deficiencies, frost injury, sun scald, over-watering, drought, soil pH that is too high or too low, and other problems can cause damaged, distorted, or yellowing leaves and can even kill plants. Plant damage can occur because:

- proper growing conditions are provided, such as appropriate fertilizer, water, or light
- the species or varieties chosen were not adapted to the site or local climate
- there may have been extreme weather conditions, such as frost or high temperatures

In addition to having good looking plants, another benefit of providing the best growing conditions is that healthy plants resist pest problems and are quickly able to outgrow damage if it does occur.

**"All-purpose" Garden Pesticides:** Pesticide products that contain both insecticides and fungicides, and products that contain mixtures of lawn fertilizers and herbicides, are widely available. Using such products increases the amount of unnecessary pesticide being released into the environment. For example, if a fungicide/insecticide product is used on roses to control a fungal disease, then there is no benefit from the insecticide component (usually more toxic than the fungicide) to offset the harm it causes to non-target organisms. Most lawns require only correct fertilization and management to remain weed-free, therefore the routine use of fertilizers containing herbicides also presents a needless hazard to people and the environment. Customers should be encouraged to buy only the pesticides they need for specific jobs and to avoid the "shot-gun" approach.

**Organic or 'Natural' Pesticides:** Pesticides approved for use on organically grown crops are derived from natural sources. This does not mean they are non-toxic. While many are low in toxicity, some, such as rotenone, pyrethrins and sulphur, are as toxic as many synthetic chemicals and can cause the same harm to non-target organisms for the short period of time they are active. All pesticides, regardless of the source, must be handled and used with care and caution.

# Tips and Recommendations

## Mixing

**Promoting Ready-to-Use pesticides:** Ready-to-use pesticides come already mixed to the correct concentration. With the exception of low risk products, such as insecticidal soaps, customers should be encouraged to purchase ready-to-use products because they:

- are less hazardous than concentrated chemicals
- do not require the user to calculate dilution rates or have special measuring utensils
- avoid the risk of spills during mixing
- avoid long-term storage of hazardous concentrate
- can be disposed of in the garbage, rather than household hazardous waste depots

A major problem with pesticide concentrates is that the containers usually hold enough to make far more spray than a customer can use up in several years. Customers often feel they are getting a deal buying concentrates because the cost per litre of mixed spray is lower than the same amount of a ready-to-use product. This is false economy if they do not actually need that much pesticide.

**Measuring Pesticide Concentrates:** If a customer buys a pesticide concentrate, they need to know that they require measuring utensils and that these must be kept separate from those used in the home for other purposes. Utensils used for pesticides should never be re-used in the kitchen. Vendors should sell suitable measuring utensils in the pesticide display area.

**Combining Pesticide Products:** Never mix two or more pesticide products together, unless they are clearly labelled for joint application (such as dormant oil and lime sulphur sprays). If a customer needs to apply two different products, they should put them on in two separate applications.

Mixing incompatible products may:

- neutralize or change the effects
- form compounds that damage plant leaves

**Using Dusts vs. Wettable Powders:** Some customers may buy a dust product expecting to mix it with water to make a spray, without realizing they need to purchase a wettable powder formulation. If they want to use a dust to make a water spray, make sure the label directions state that the product is suitable for spraying. Dusts are almost impossible to mix into water unless they are formulated as wettable powders and are likely to be inhaled during the prolonged (and messy!) mixing process.

## Application

**Recommending Spot-Treatments:** Whenever possible, recommend that customers apply pesticides on a "spot" basis to individual plants or small target areas, rather than using broadcast applications. For example, suggest they spot spray individual lawn weeds, rather than apply a selective herbicide to the entire lawn area. This reduces the amount of pesticide required, which will:

- minimize health risks
- minimize the risk of harming the environment
- save the customer money

**Using Pesticides Indoors:** Pesticides to be used indoors must be labelled for indoor use. Dispensers should be able to advise customers of the following precautions for using indoor pesticides:

- Remove pets (including birds) and children's toys from the area and cover fish tanks before using pesticides on floors or furniture.

- Remove all food, dishes, and utensils before kitchen cabinets are treated for household insects.

- Do not try to fill a room with aerosol mist or mist from a spray applicator. The insecticides are intended to kill the insects when then come in contact with the sprayed surfaces.

- Use a trigger pump sprayer ("squirt-gun") or hand-held aerosol applicator for indoor treatments, rather than a compressed-air sprayer. An inexperienced person can easily apply too much pesticide using a compressed-air sprayer.

**Spraying Pesticides Outdoors:** Dispensers should be able to advise customers of the following precautions for spraying outdoors:

- Pesticides must not be allowed to drift onto neighbouring properties. To prevent drift, customers should spray when there is minimal wind. Early in the morning or later in the evening are often the stillest.

- Before spraying nearby areas, remove children's toys, lawn furniture, pets, and cover fish ponds.

**Using Herbicides:** Customers should know that systemic herbicides, those absorbed into a plant and move through it to the roots, only work when weeds are actively growing. Applying these herbicides when weeds aren't growing not only doesn't work, but is a waste of time and money, and needlessly burdens the environment.

**Using Insecticides:** Tips for insecticide use:

- Never spray fruit trees while they are in bloom or other plants in flower as such treatments can harm foraging honeybees.
- Know the life cycle of insect pests (especially those that are hard to see during the day). This will help the customer know when to spray for best effect. For example, spraying trees for tent caterpillars or rhododendrons for black vine weevils will only work for the few weeks of the year that these stages of the insects are present on the plant.

## Safety

**Pesticides on Food Plants:** A few key precautions for treating edible plants are:

- Before treating edible plants, make sure the product label states that it can be used on the specific plants to be treated.
- Do not harvest crops until the minimum number of days have elapsed after the pesticide application (see days-to-harvest on the pesticide label).

## Disposal

**Disposing of Unwanted Pesticides:** Any liquid ready-to-use products and any Domestic products that do not have a "skull-and-crossbones" poison symbol on the label can be disposed of in the household garbage. Pesticides that carry the poison symbol, such as rodent baits and certain concentrates, must be disposed of in household hazardous waste collection depots located throughout the province (for locations, call the Consumer Product Stewardship Program: 1-800-505-0139).

# Study Questions: Chapter 6 - Pesticide Use Reminders

*Answers are given in the back of this manual*

1. What are two common misconceptions customers have about pesticide use?
2. Why are "all-purpose" pesticide products, containing mixtures of pesticides, generally not recommended?
3. List three advantages of using ready-to-use pesticide products over concentrate products.
4. What are the advantages of using spot-treatments over broadcast treatment?
5. What should be removed from areas where pesticides are going to be used indoors? What type of pesticide application equipment should be recommended to customers planning to spray indoors?
6. Why should someone thinking of spraying an insecticide know the life cycle of the target pest?

# SECTION II

## Common Domestic Pesticides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CHAPTER 7

# INSECTICIDES

## Learning Objectives

When you have completed this chapter, you should be able to:

1. *Describe the properties of common insecticides available for home and garden pests, including:*
   - *insects controlled*
   - *area of use*
   - *activity and residual effects*
   - *toxicity to people, wildlife or pets*
2. *List "preferred" insecticides that should generally be recommended for home and garden use.*
3. *List higher risk insecticides and describe precautions for using them.*

## Introduction

This chapter lists the key characteristics of 14 commonly used insecticide active ingredients. The active ingredient is shown on every pesticide product label after the word **GUARANTEE**. Dispensers should have a good understanding of this group of pesticides because it includes commonly used insecticides (according to a survey of BC pesticide vendors) and preferred insecticides.

Dispensers should be able to explain how each pesticide works, the pests it controls, and safety precautions.

**Preferred Insecticides:** Dispensers should know which insecticides are "preferred" for use by home and garden customers and why. These insecticides should be the first choice because they include products that:

- Present the least short and long-term health risk to humans
- Have the lowest environmental impact, due to short residual effects and specificity to target pests

**Other Insecticides:** Products containing more toxic or persistent chemicals (such as organophosphorous and carbamate insecticides) are in this chapter under Other Insecticides. In general, these are products of last resort, due to their toxicity, risk of harming non-target organisms and problems with storage and disposal. It is essential that customers know what safety equipment is recommended for using these insecticides.

There are also many, less frequently used, insecticides that are not described here. Dispensers should be able to look up information on these in other reference resources as needed.

If a customer has not selected a pesticide and wants to know what to use for a particular pest problem, see Section III on Pest Management, in this manual.

**Information in this chapter is intended only as a guide.**

**Always apply pesticides according to directions on the label.**

# Preferred Insecticides

## *Bacillus thuringiensis* (Kurstaki) or BTK

### General Description

- Common species of soil bacteria that produce spores and protein crystals that infect and kill caterpillars
- Causes caterpillars to stop feeding and eventually starve to death
- Affects some species of caterpillars only (larvae of moths and butterflies)
- Sold as liquid concentrate or wettable powder
- Non-toxic to other insects, animals and people
- Residual effects are short, lasting only several days in the environment

### Insects Controlled

**Leaf-eating caterpillars:** armyworms, cabbage loopers, cankerworms, cutworms, diamond back moth larvae, European corn borers, imported cabbageworms, leafrollers, spruce budworms, tent caterpillars, and tomato fruitworms

### Areas of Use

Use BTK in greenhouses, and on outdoor vegetables, shade trees, fruit trees, and ornamentals.

### Application Notes

- Caterpillars must eat sprayed foliage to be affected
- Caterpillars stop feeding immediately after eating sprayed foliage, but may not die for 2-5 days
- Avoid application before rain or irrigation as it will be washed off
- Non-phytotoxic

### Precautions

Shake sprayer periodically during use to ensure product is properly mixed.

### Health and Environmental Information

- Non-toxic to mammals because bacteria does not grow in warm-blooded creatures
- Non-toxic to birds that eat sprayed caterpillars
- Does not harm fish, bees, other insects, or earthworms
- Non-persistent, as spores and protein crystals break down in a few days
- May be used up until day of harvest on edible crops

# Boric Acid (For herbicidal borates, see Chapter 8, Herbicides)

## General Description

- Manufactured from borax, which is mined from deposits in the earth
- Acts as a stomach-poison
- Formulated in dusts, baits, and ready-to-use liquids
- Extremely long residual effects if kept dry

## Insects Controlled

**Structural pests:** carpenter ants, other ants, cockroaches, silverfish, and other crawling insects.

## Areas of Use

Indoors and outdoor living areas.

## Application Notes

- Place baits along ant runs and in cracks where ants are seen
- Apply as a very fine layer of dust in protected locations, where insects are known to travel
- Dusts must be kept dry

## Precautions

- Apply baits out of reach of children and pets
- Do not apply around growing plants, including trees and shrubs, as it may kill or seriously retard plant growth
- Do not apply near stored food or where food is handled, such as cupboards and kitchen counters

## Health and Environmental Information

- Low toxicity to people and animals
- No long-term environmental hazards associated with use indoors
- Remains toxic to insects until removed or washed away

# Horticultural (Supreme) Oils: Dormant and Summer Oils

## General Description

- Mineral oil, emulsified to mix in water
- Broad-spectrum insecticide and miticide
- Acts upon contact, by suffocation and by disrupting other physical processes
- Sold as liquid concentrates
- No residual effects

## Insects Controlled

- **Dormant oil:** overwintering eggs of aphids and some moths, mealybugs, pear psylla, pear and rose slugs, scales, and spider mites
- **Summer oil**: mealybugs, rust mites, scales, spider mites, and whiteflies

## Areas of Use

Outdoors on woody ornamentals and fruit trees, including roses, shade trees, fruit trees, bushes, some evergreens, and other hardy shrubs.

- Use dormant oils when deciduous woody trees and shrubs are dormant, after leaves drop in the fall or before growth starts in the spring
- Use summer oils on evergreens, (with some exceptions) deciduous trees, and shrubs during the growing season

## Application Notes

- Mix with lime sulphur as a pre-foliar or dormant spray for the control of insect, mites, and fungus diseases (see entry on Sulphur, pg. 104 for more information)
- Apply oils only to healthy plants, not suffering from disease, heat or drought stress
- Phytotoxic to some plants, such as apricots, blue spruce, maple, and ferns (check labels for list of plants that cannot tolerate oil sprays)

## Precautions

- Do not use oil sprays or lime sulphur sprays within 30 days of each other during the growing season
- Do not use dormant sprays when freezing weather is predicted or when foliage is wet (spray should have time to dry before rainfall or heavy dew forms)
- Do not use summer oils in hot weather (over 30°c), under dry conditions, or when temperatures below freezing are expected within a few weeks
- To prevent injury to plants, agitate the mix while spraying to keep the oil properly emulsified
- Do not over apply oil as injury to plants may result

## *Health and Environmental Information*

- Low mammalian toxicity, but harmful if swallowed
- Summer oils reduce the populations of some beneficial insects and mites
- Low toxicity to fish and wildlife
- Non-persistent

# Insecticidal Soap

## General Description

- Bio-degradable fatty acids, similar to those in household soaps
- Acts upon contact action against insects and mites
- Broad-spectrum control
- Sold as ready-to-use products and liquid concentrates
- Also sold mixed with other insecticides, such as pyrethrins
- No residual effects

## Insects Controlled

**Plant pests:** aphids, earwigs, mealybugs, pear and roseslugs, psyllids, scales, spider mites, whiteflies and other insects

## Areas of Use

- On foliage of vegetables, flowers, fruit trees, and ornamentals, which are outdoors
- On indoor houseplants

## Application Notes

- Must contact insects at time of application to work
- Thoroughly spray all plant surfaces
- Repeat applications may be necessary

## Precautions

- Limit number of times soap is applied to the same foliage as it can damage leaves of some plants
- Phytotoxic to bleeding heart, crown of thorns, gardenia, horse chestnut, Japanese maple, maidenhair fern, mountain ash, poinsettias, and sweet peas (check label for plants that cannot tolerate soap sprays)

## Health and Environmental Information

- Low toxicity, but eye and mucous membrane exposure may cause irritation
- Kills beneficial insects as well as pests upon contact
- Non-toxic to fish and wildlife
- Non-persistent (may be used up until day of harvest on edible crops)

# Lime Sulphur

See pg. 103 under Preferred Fungicides. This is a fungicide as well as an insecticide and miticide.

# Pyrethrins

## General Description

- Extracted from pyrethrum daisies
- Acts upon contact
- Broad-spectrum control of crawling and flying insects
- Sold as ready-to-use liquids, liquid concentrates, and dusts
- Also sold in mixtures with other insecticides and fungicides
- No residual effects

## Insects Controlled

- **Plant pests**: aphids, caterpillars, flea beetles, leafhoppers, beetles, thrips, spider mites, stinkbugs, whiteflies, and boxelder bugs
- **Structural pests**: ants, cockroaches, earwigs, fleas, flies, mosquitoes, gnats, and yellowjackets
- **Pet pests:** fleas and ticks

## Areas of Use

- Outdoors on vegetables, fruit, and ornamentals
- Indoors for structural and houseplant pests
- On pets

## Application Notes

- Do not apply in direct sunlight or when temperature exceeds 32° C
- Apply in the evening or on a cloudy day
- Apply when air is still to avoid drift
- Apply dust products as very thin coating (thick dust repels insects)
- Generally non-phytotoxic with a few exceptions

## Precautions

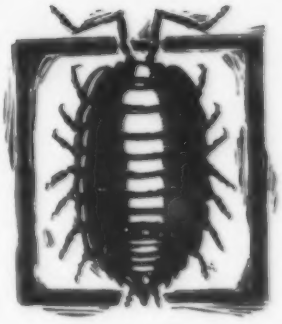
- Contact with skin or inhalation may cause allergic reactions in sensitive people
- Do not use products formulated for plants on pets and visa versa
- May be phytotoxic to maidenhair fern, other delicate ornamentals, and seedlings

## Health and Environmental Information

- Moderate toxicity to mammals, avoid contact with skin and eyes
- Toxic to fish and beneficial insects
- Low toxicity to other wildlife
- Non-persistent (may be used up until day of harvest on edible crops)

# Silicon Dioxide (Diatomaceous Earth)

## General Description



- Ground up, fossilized shells of diatoms (a type of algae) from natural deposits
- Acts upon contact against insects by causing them to dry up
- Broad-spectrum control, kills most insects that contact it
- Most products are dusts, some are wettable powders
- Long residual effects, if kept dry and not dispersed

## Insects Controlled

- **Structural and nuisance pests:** ants, beetles, cockroaches, fleas, earwigs, silverfish, sowbugs, and other crawling insects
- **Plant pests**

## Areas of Use

- Indoors and outdoor living areas
- Outdoors on plants (spot application only recommended)

## Application Notes

- Apply dusts in very thin coating (thick dust repels insects)
- Non-phytotoxic

## Precautions

- Kills beneficial insects
- Limit use on outdoor plants to spot treatments (around stems of cabbage to control cabbage root flies, or around seedlings to control sowbugs)
- Avoid inhalation, as dust can irritate mucous membranes

## Health and Environmental Information

- Non-toxic to people, other mammals, birds, fish, and earthworms
- May be used up until day of harvest on edible crops
- As long as dust is present, will remain active against insects, including beneficial insects
- Persists for years if kept dry (for example, inside wall voids)
- Short residual effects where dusts become wet or dispersed

# Other Insecticides

## Carbaryl

### General Description

- Synthetic insecticide with broad-spectrum effect
- Acts upon contact by disrupting nervous system of insects
- Sold as dusts, ready-to-use liquids, liquid concentrates, wettable powders and baits
- Also sold mixed in products with fungicides and other insecticides
- Relatively short residual effects

### Insects Controlled

- **Plant pests:** aphids, beetles, caterpillars, earwigs, leafhoppers, leafminer adults, tarnished plant bugs, peach borers, pear psylla, scales, and sod webworms
- **Structural pests:** ants and yellowjackets

### Areas of Use

- Outdoors on lawns, ornamentals, fruit trees, vegetable gardens, flowers, and as a pre-planting soil treatment
- Outdoors on exterior of buildings for structural pests

### Precautions

- Do not use during bloom or when bees are present as it is highly toxic to bees
- Carbaryl is phytotoxic to sensitive ornamentals such as maidenhair fern
- Do not apply to tender or wet foliage as leaf injury may occur
- Damage will occur if several days of rain or high humidity follow application
- Delay use until at least 30 days after full bloom to avoid undesired apple thinning

### Health and Environmental Information

- Moderate mammalian toxicity, but a suspected endocrine disrupting chemical
- Very toxic to bees, beneficial insects, earthworms, and fish
- Low toxicity to birds
- Moderately persistent (product labels list minimum 7 days to harvest for edible crops)

# Chlorpyrifos

## General Description

- Synthetic insecticide with broad-spectrum effect
- Acts upon contact by disrupting the nervous systems of insects and mites
- Sold as granules, dusts, ready-to-use liquids and liquid concentrates
- Also sold in mixed products with other insecticides
- Longer residual effect than most pesticides

## Insects Controlled

- **Plant pests**: aphids, ants, cutworms, earwigs, leafhoppers, mealybugs, mites, peach borers, scales, sod webworms, sowbugs, thrips, and white grubs

- **Structural pests:** ants, carpet beetles, carpenter ants, cockroaches, earwigs, fleas, silverfish, sowbugs, spiders, ticks, and yellowjackets

## Areas of Use

- Outdoors on lawns and ornamentals, vegetables, flowers, and as a pre-plant soil treatment
- Indoors for structural and houseplant pests

## Application Notes

- Non-phytotoxic to most species of plants when used at recommended rates
- Remove houseplants out-of-doors for treatment

## Precautions

- Do not use during bloom or when bees are present as it is highly toxic to bees
- Chlorpyrifos is phytotoxic to some tender ornamentals such as poinsettias, azaleas, camellias, roses, and variegated ivy
- The long days-to-harvest interval is required (30-70 days) on most edible plants
- Check labels carefully, as some products are not for use on, or near, edible crops

Some product labels advise no more than one application per season on edible plants, two applications per year on ornamentals and at least two months between applications for structural pests.

## Health and Environmental Information

- Moderate mammalian toxicity and a suspected endocrine disrupting chemical
- Extremely toxic to birds, fish, bees, and other wildlife
- Relatively long persistence (product labels list 30-70 days to harvest for most edible crops)

# Diazinon

## General Description

- Synthetic insecticide with broad-spectrum effect
- Acts upon contact by disrupting nervous system of insects and mites
- Sold as ready-to-use liquids, liquid concentrates, dusts, granules, and wettable powders
- Moderate residual effects

## Insects Controlled

- **Plant pests** (on foliage and in soil): aphids, root maggots, caterpillars, beetles, earwigs, leafminers, leafhoppers, leatherjackets, plant bugs, mealybugs, root weevils, scales, spider mites, springtails, thrips, white grubs, and whiteflies

- **Structural pests:** ants, carpenter ants, carpet beetles, and fleas

## Areas of Use

- Outdoors on lawns and ornamentals, flowers, fruit trees, and vegetables
- Outdoors as pre-plant soil treatment or soil drench
- Indoors for structural and houseplant pests

## Application Notes

Generally not phytotoxic, with some exceptions.

## Precautions

- Do not use during bloom or when bees are present as it is highly toxic to bees
- Do not apply granular products for application to soil as there is a high risk of killing birds
- Use liquid soil-drench formulations
- Products packaged in glass are a breakage hazard
- Phytotoxic to stephanotis, African violets, some ferns, tropical plants, and some lettuce varieties

## Health and Environmental Information

- Careless handling and widespread use made diazinon poisonings four times higher than any other reported pesticide poisoning in BC in 1991 (44 cases)
- Moderate toxicity to mammals
- Highly toxic to bees and other beneficial insects, birds, fish, and wildlife
- Moderately persistent (product labels list 5-20 days to harvest for most edible crops)

# Dimethoate

## General Description

- Synthetic insecticide with broad-spectrum effect
- Contact and systemic actions against insects and mites
- Only common insecticide with systemic activity
- Sold as liquid concentrates
- Long residual effects

## Insects Controlled

**Plant pests:** aphids, beetles, leafhoppers, leafminers, scales, spider mites, tarnished plant bugs, thrips, and whiteflies

## Areas of Use

- Outdoors on foliage of flowers, fruit trees, ornamental trees and shrubs
- Outdoors as a paint-on application to tree trunks or as a soil drench to control birch leafminers

## Application Notes

Use only on plants listed on label.

## Precautions

- Do not use during bloom or when bees are present—it is highly toxic to bees
- Do not use as a foliar spray when temperatures are excessively high
- Place well above the reach of children when applying to tree bark
- Keep children and pets away from treated area when applying into ground as a soil drench
- Phytotoxic to some maples, elms, walnuts, apples, pines, some ornamentals
- Check for tolerance on individual plants before it is applied to the entire plant or planting
- Avoid breathing vapour or spray mist
- Avoid contact with skin, eyes, clothing—in short: be cautious when using this pesticide

## Health and Environmental Information

- High mammalian toxicity
- Highly toxic to birds, bees, and other wildlife
- Moderately persistent (some product labels list 14 - 21 days to harvest for tree fruit)

# Malathion

## General Description

- Synthetic insecticide with broad-spectrum effect
- Contact action against insects and mites
- Sold as ready-to-use and concentrated liquids, dusts, and wettable powders
- Also sold in mixed products with other insecticides
- Relatively short residual effect

## Insects Controlled

- **Plant pests**: aphids, caterpillars, leafhoppers, leafminers, mealybugs, root weevils, scales, spider mites, tarnished plant bugs, thrips, and whiteflies

- **Structural pests:** flies, mosquitoes, hornets, and wasps

## Areas of Use

- Outdoors on vegetables, fruit trees, shrubs, and other ornamentals
- Outdoors on exteriors of structures and outdoor living areas

## Application Notes

Use only on plants listed on labels.

## Precautions

- Do not use during bloom or when bees are present as it is highly toxic to bees
- Phytotoxic to many plants, including hickory, *Viburnum* spp., Some junipers, *Spirea* spp., White pines, maples, elms, petunias, orchids, ferns, some apple, pear and grape varieties
- Do not apply within three weeks of blossom fall or thinning of apples may result

## Health and Environmental Information

- Low mammalian toxicity
- Extremely toxic to bees and fish
- Moderately toxic to birds
- Moderately persistent (product labels list 7-21 days to harvest for most edible crops)

# Methoxychlor

## General Description

- Synthetic insecticide with broad-spectrum effect
- Acts upon contact
- Commonly sold as ready-to-use and concentrated liquids, dusts
- Also sold as a mix with other insecticides and/or fungicides
- Moderate residual effects

## Insects Controlled

- **Plant pests:** caterpillars, beetles, fruit flies, leafhoppers, leafrollers, tarnished plant bugs, root weevils, and thrips

- **Structural pests:** ants, blackflies, carpet beetles, fleas, flies, flying moths, gnats, hornets, yellowjackets, and mosquitoes

## Areas of Use

- Outdoors on vegetables, flowers, ornamentals, fruit trees, and berry plants
- Outdoors on exterior of structures and outdoor living areas
- Indoors for structural pests

## Application Notes

Use only on plants listed on labels.

## Precautions

- Do not use during bloom or when bees are present as it is highly toxic to bees
- Phytotoxic to some cucumber and squash varieties, petunia, African violets, *Crassula*, some varieties of Juniper, elm, other evergreens, and ornamentals

## Health and Environmental Information

- Low mammalian toxicity, but a suspected endocrine disrupting chemical
- Slightly irritating to skin
- Highly toxic to fish, bees and wildlife
- Moderately persistent (product labels list 7-21 days to harvest for most edible crops)

# Propoxur

## General Description

- Synthetic insecticide with broad-spectrum effect
- Acts on contact (has rapid knock-down ability)
- Sold as ready-to-use sprays, indoor baits such as ant traps
- Also sold as a mix with other insecticides
- Long residual effects

## Insects Controlled

- **Structural pests:** ants, carpenter ants, carpet beetles, cockroaches, earwigs, silverfish, spiders, sowbugs, and yellowjackets

- **Pet pests**: fleas and ticks

## Areas of Use

- Outdoors on exterior of structures, outdoor living areas, and wasp and hornet nests
- Indoors for structural pests
- Some products for pet pests

## Application Notes

No Domestic products are available for use on plants.

## Precautions

- Use only pet product formulations on pets
- Do not spray plants or grass

**Be cautious when using this pesticide!**

## Health and Environmental Information

- Moderate mammalian toxicity
- Highly toxic to bees, fish, and birds
- Persists for several weeks to months

# Pyrethroids, Synthetic

## General Description

- Synthetic insecticides that chemically resemble natural pyrethrins, such as permethrin, allethrin, resmethrin, and tetramethrin
- Broad-spectrum effect
- Acts upon contact on insects and mites
- Sold as ready-to-use and concentrated liquids and also sold mixed with other insecticides
- moderate residual effects

## Insects Controlled

- **Plant pests:** including aphids, beetles, boxelder bugs caterpillars, flea beetles, fungus gnats, leafhoppers, sawflies, tarnished plant bugs, and whiteflies.
- **Structural pests:** ants, carpet beetles, clothes moths, cockroaches, earwigs, flies, silverfish, spiders, yellowjackets, and hornets
- **Pet pests:** fleas and ticks

## Areas of Use

- Some products containing permethrin are also for use on edible plants
- Outdoors on exteriors of structures, outdoor living areas, and for wasp and hornet control
- Indoors for structural, houseplant, and pet pests, outdoors on ornamentals

## Application Notes

Synthetic pyrethroid products are of three types: application to surfaces (indoors or outdoors), application to plants, or application on pets. Many products are only for one type of application, therefore check labels carefully before selecting.

- Only a few Domestic products (and these only contain permethrin) are registered for use on edible crops
- Spray on cloudy days or in evening to prevent leaf burn

## Precautions

- Do not use during bloom or when bees are present as it is highly toxic to bees
- Some formulations are phytotoxic to delicate plants such as coleus and African violet
- Phytotoxic to other plants when applied in full sun and high temperatures
- Test tree and shrub species for phytotoxicity prior to application on whole plants

## Health and Environmental Information

- Low to moderate toxicity to mammals and birds, depending on the specific pyrethroid
- Can cause eye and skin irritation
- Highly toxic to fish and bees
- Moderately persistent (labels list 3-21 days to harvest for most edible crops)

# Study Questions: Chapter 7 - Insecticides

*Answers are given in the back of this manual.*

1. Which pesticide(s) would be the preferred choice for controlling:
   a) imported cabbageworm on cabbage?
   b) scale insects on an ornamental tree?
   c) silverfish in a bathroom?

2. Choose the list with the most insecticides that are highly toxic to bees:
   a) boric acid, chlorpyrifos, diazinon, propoxur, glyphosate.
   b) carbaryl, chlorpyrifos, dimethoate, malathion, permethrin.
   c) chlorpyrifos, diazinon, dimethoate, propoxur, silicon dioxide.
   d) diazinon, dimethoate, insecticidal soap, methoxychlor, propoxur.
   e) none of the above.

3. Identify which insecticide(s) is (are) phytotoxic to at least some plants:
   a) *Bacillus thuringiensis*
   b) dimethoate
   c) diazinon
   d) pyrethrins
   e) (b) and (d)
   f) (c) and (d)

# CHAPTER 8

# HERBICIDES

## Learning Objectives

When you have completed this chapter, you should be able to:

1. *Describe the properties of common herbicides available for yard and garden use, including:*
   - *weeds controlled*
   - *area of use*
   - *activity and residual effects*
   - *toxicity to people, wildlife or pets*
2. *Describe a 'preferred' herbicide recommended for yard and garden use.*
3. *List higher risk herbicides and describe precautions for using them.*

## Introduction

This chapter lists the key characteristics of 10 commonly used herbicides and the active ingredients (according to a survey of BC pesticide vendors). The active ingredient is shown on every pesticide product label after the word **GUARANTEE**. Dispensers should have a good understanding of these pesticides because they are so frequently used around yards and gardens.

Dispensers should be able to explain how each herbicide works, the plants it controls, and safety precautions.

**Preferred Herbicides:** Dispensers should know which herbicide is 'preferred' for use by home and garden customers and why. Fatty acids should be the first choice for yard and garden customers because it:

- Presents the least short- and long-term health risk to humans
- Has the lowest environmental impact primarily due to short residual effects

**Other Herbicides:** Products containing more toxic or persistent chemicals are in this chapter under Other Herbicides. In general, these are products of last resort, due to their toxicity, risk of harming non-target plants, persistence or problems with storage and disposal. It is essential that customers know what safety equipment is recommended for using these herbicides.

There are other less frequently used herbicides than those described here. Dispensers should be able to look up information on these in other reference resources as needed.

If a customer has not selected a herbicide and wants to know what to use for a particular problem, see Section III, Pest Management.

**Mixed Fertilizer/Herbicide Products:** Using mixed products can result in unnecessary herbicide use because lawns usually need fertilizers more often than they need herbicides. In fact, a well fed and managed lawn should need little, if any, treatment with herbicides to keep it weed-free. The small amount of herbicide that may be required is best applied in spot treatments. Combination herbicide/fertilizer products should only be used on established lawns (they are damaging to new lawns), and usually as a last resort. For example, it might be appropriate to use them to renovate lawns that have severe weed infestations. Customers should be advised to use a drop spreader and not a broadcast fertilizer spreader when using combination products. This is because granules can accidentally be thrown onto desirable vegetation, damaging or killing the plants.

**Information in this chapter is intended only as a guide.**

**Always apply pesticides according to directions on the label.**

# Preferred Herbicides

## Fatty Acids

### General Description

- Naturally occurring fatty acid compound
- Non-selective herbicide that acts on contact to kill foliage of most plants
- Fast acting, can show results within 2 hours
- No herbicidal activity in soil, non-residual

### Weeds Controlled

- **Annual plants:** grasses, redroot pigweed, lamb's- quarters, corn spurry, mustards, and chickweed
- Provides suppression or top-kill of some perennials including plantain

### Areas of Use

Use fatty acides outdoors around shade trees, nurseries, parks, sidewalks, driveways, mulch, fence posts, greenhouses and before planting grasses, ornamentals and vegetables.

### Application Notes

Apply fatty acids in spring or summer to actively growing weeds less than 13 cm tall.

### Precautions

- Do not plant in fatty acid treated soil for three days after treatment
- Do not apply fatty acids if rainfall is expected within two hours
- Avoid spray drift on desirable plants

### Health and Environmental Information

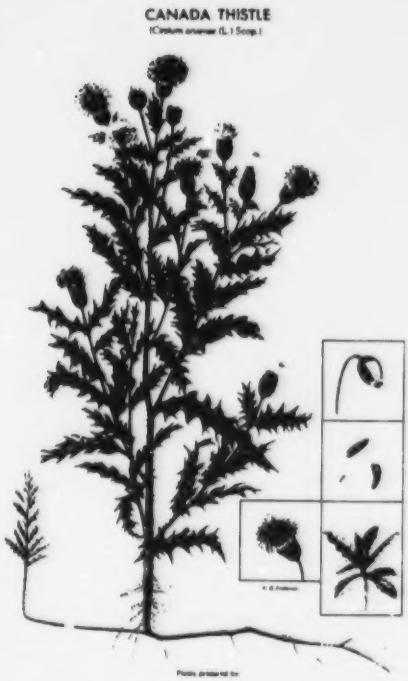
- Very low mammalian toxicity
- Moderately irritating to skin, eyes, and throat
- Low toxicity to fish and wildlife
- Non-persistent

# Other Herbicides

## Glyphosate

### General Description

- Synthetic amino acid herbicide
- Non-selective herbicide that can kill any plant, including well-established trees
- Readily absorbed through leaves and moves through stems and roots to kill entire plant
- Sold as ready-to-use and concentrated liquids
- Some herbicidal activity in soil, non-residual




### Weeds Controlled

**Annual and perennial plants:** alder, bentgrass, blackberry, brush, chickweed, crabgrass, dock, grasses, horsetail, Johnsongrass, knotweed, lambsquarters, maple, milkweed, morning glory, mustards, oxalis, pigweed, plantain, poplar, purslane, quackgrass, raspberry, sedges, and thistles

### Areas of Use

- Outdoors around buildings, vacant lots, and storage and recreational areas
- Outdoors to prepare or renovate beds before planting ornamentals, vegetables, or lawns

### Application Notes

- Apply to vigorously growing annuals anytime
- Apply to perennials after seed heads, berries, or flowers appear
- Re-treatment may be necessary as seeds continue to germinate through season
- Cut large or rampantly growing vegetation (for example, blackberry, brushy species) to the ground, then treat re-growth after it sprouts from stumps
- Visible symptoms may require a week or more to appear, with burndown usually in 2-4 weeks
- Do not spray to the point of run-off as effectiveness is reduced if glyphosate is overapplied (because top dies before the plant has a chance to move the herbicide down to the roots) and there is greater risk to non-target plants

## Precautions

- Do not use in vegetable gardens, flower beds, around shrubs or ornamental plants, or on lawns because it can kill or damage any plant contacted
- Mix concentrates only with clean water; dirty water will deactivate the glyphosate
- Avoid drift or accidental application to desirable plants (do not spray in windy conditions), damage to non-target plants from glyphosate drift is quite common
- Do not apply if rainfall is forecast for the time of application (rainfall occurring within six hours of application will reduce effectiveness)
- Do not mix or store in galvanized metal containers as it can react with the metal to release gases

## Health and Environmental Information

- Low mammalian toxicity
- May cause eye and skin irritation
- Low toxicity to fish, birds and other wildlife
- Moderately persistent in soil (though not herbicidal), depending on conditions

# *2,4-D*, Dicamba & Mecoprop (Used as a mixture or separately)*

## *General Description*

- Synthetic herbicides that control broadleaf plants only and do not affect grasses
- Absorbed into plant cells and disrupts plant growth
- Sold as ready-to-use liquids, concentrated liquids or granular formulations
- Also sold in mixtures with fertilizers
- Moderate to long residual effects (dicamba has the longest effects, lasting 3-12 months)

## *Weeds Controlled*

- **Mixture:** a wide range of annual and perennial broad-leaf plants
- **2,4-D alone:** bindweed, catsear, dandelions, heal-all, knapweeds, morning glory, pearlwort, pigweed, and plantain
- **Dicamba alone:** buckwheats, chickweed, clover, dock, English daisy, knotweed, smartweed, thistles, and velvetleaf
- **Mecoprop alone:** black medic, buttercup, chickweed, clover, corn spurry, dock, English daisy, knotweed, lambsquarters, mallow, mustards, oxalis, plantain, purslane, and veronica

## *Areas of Use*

Use outdoors on lawns and non-crop areas.

## *Application Notes*

- Post-emergence herbicides
- Dicamba is also used as a pre-plant and pre-emergence herbicide
- Post-emergence herbicides are most effective on young, rapidly growing plants
- Temperature during application should be between 10°c and 32°c
- Use a drop spreader when applying combination fertilizers and herbicides
- Mecoprop acts relatively slowly, requiring 3-4 weeks for control

## *Precautions*

- Do not use for controlling weeds in vegetable gardens, flower beds, around shrubs or ornamental plants
- Apply only to well-established lawns and do not use on lawns that are drought-stressed and or in unusually hot or wet weather
- Avoid drift or accidental application to desirable plants. (do not spray in windy conditions or use broadcast spreaders for granular formulations)

**Note:** Misapplication of 2,4-D and dicamba are a common cause of reduced vigor or death of lawns, trees, and shrubs.

*2,4-Dichlorophenoxyacetic Acid

## Health and Environmental Information

### *2,4-D:*

- Moderate mammalian toxicity and a suspected endocrine disrupting chemical
- Moderately toxic to birds and other wildlife
- Low toxicity to honeybees and earthworms
- Persists 1-4 weeks in soils, longer in cold, dry soil

### *Dicamba and Mecoprop:*

- Low mammalian toxicity
- May cause eye irritation
- Low toxicity to fish and wildlife
- May persist in soils in dry conditions
- Relatively mobile in moist soil (dicamba only)

# Soil Sterilants - Amitrole, Borate, Bromacil, Dichlobenil, Simazine

## General Description

- Synthetic insecticides with long residual effects on all plants
- Sold as ready-to-use and concentrated liquids and granulars
- Also sold mixed with other herbicides

### Amitrole

- Synthetic triazole herbicide
- Post-emergence herbicide
- Absorbed by roots and foliage and moves through plant to growing tips
- Moderate residual effect, generally persists in soil 2-4 weeks

### Borate

- Manufactured from borax, which is mined from deposits in the earth
- Pre-emergence and post-emergence herbicide
- Absorbed through roots and causes plant tissues to dry up
- Long residual effect, sterilizes soil up to one season

### Bromacil

- Synthetic uracil herbicide
- Post-emergence herbicide
- Absorbed through roots and moves through growing plant
- Long residual effect, persists in soil up to six months

### Dichlobenil

- Synthetic benzonitrile compound
- Pre-emergence herbicide for germinating annual and perennial seedlings
- Affects growing tips of plant roots
- Long residual effects, persists in soil 2-12 months

### Simazine

- Synthetic triazine compound
- Pre-emergence herbicide (at low rates) for germinating annual and perennial seeds
- Post-emergence herbicide (at higher rates) to kill all vegetation
- Absorbed through roots, moved to growing shoots
- Long residual effects, breaks down slowly in soil, not readily leached from soil

## Weeds Controlled

Annual and perennial broad-leaved plants and grasses.

## Areas of Use

- Outdoors around driveways, walkways, patios, walls, fences, and similar areas
- Simazine and dichlobenil at low rates can be applied around some well-established woody plants to control weeds if proper precautions are taken (follow label directions carefully)

## Application Notes

- Make sure no roots of non-target plants reach into the treatment areas as they will take up the herbicide and be killed. Unless stated otherwise on the label, to protect desirable plants, applications should be kept at least two metres out from the drip line or from where the roots may be expected to reach.

- Unless otherwise stated on the label, applications should be no closer to a tree than a distance equal to twice the height of the tree.

- Do not apply to slopes or flood the area after applying soil sterilants as they can move downhill to non-target plantings via irrigation or rainfall runoff.

## Precautions

- Do not use soil sterilants to control weeds in lawns, vegetable beds, or flower beds during the growing season. Some products can be used on established woody planting and during the dormant season.

- Use only around woody ornamentals and trees listed on the labels.

- Avoid drift or accidental application to desirable plants. Do not spray in windy conditions or apply where runoff can move the chemical out of the treatment area.

- Some products can make an area unsuitable for growing plants for up to two years and remain phytotoxic for up to five years.

## Health and Environmental Information

- Low mammalian toxicity; amitrole is a suspected endocrine disrupting chemical
- Some products may cause skin and eye irritations
- Low toxicity to fish and wildlife
- Moderately to extremely persistent in the environment

# Study Questions: Chapter 8 - Herbicides

*Answers are in the back of the manual.*

1. Describe the difference between a foliar applied herbicide and a soil sterilant with respect to where they are used and persistence in the environment.
2. List three herbicides that control broadleaf plants but not grasses.
3. List three precautions for using glyphosate.

CHAPTER 9

# FUNGICIDES

## Learning Objectives

When you have completed this chapter, you should be able to:

1. *Describe the properties of common fungicides available for yard and garden use, including:*
   - *fungi controlled*
   - *area of use*
   - *activity and residual effects*
   - *toxicity to people, wildlife or pets*
2. *Describe 'preferred' fungicides recommended for yard and garden use.*
3. *List higher risk fungicides and describe precautions for using them.*

## Introduction

Most products available for controlling plant diseases are fungicides, meaning they control the various species of fungi that attack plants. This chapter lists the key characteristics of three commonly used fungicide active ingredients (according to a survey of BC pesticide vendors). The active ingredient is shown on every pesticide product label after the word GUARANTEE. Dispensers should have a good understanding of these pesticides because they are so frequently used around yards and gardens.

Dispensers should be able to explain how each fungicide works, the diseases they control, and safety precautions that should be taken while using them.

**Preferred Fungicides:** Dispensers should know which fungicides are 'preferred' for use by home and garden customers and why. These should be the first choice for yard and garden customers because they include products that:

- Present the least short- and long-term health risk to humans
- Have the lowest environmental impact primarily due to short residual effects

**Other Fungicides:** Products containing more toxic or persistent chemicals are listed in this chapter under Other Fungicides. In general these are products of last resort due to the toxicity, risk of harming non-target organisms, and persistence or problems with storage and disposal. It is essential that customers know what safety equipment is recommended for using these fungicides.

There are other less frequently used fungicides and other plant disease products than those described here. Dispensers should be able to look up information on these in other reference resources as needed. If a customer has not selected a fungicide and wants to know what to use for a particular disease problem, see Section III, Pest Management, in this manual.

**Information in this chapter is intended only as a guide.**

**Always apply pesticides according to directions on the label.**

# Preferred Fungicides

## Lime Sulphur

### General Description

- Calcium sulphur compound
- Broad-spectrum control of fungi, also mites and some insects
- Sold as liquid concentrates
- No residual effects

### Pests Controlled

- **Plant diseases:** black knot, black spot, brown rot, powdery mildew, rusts, apple and pear scab, and peach leaf curl
- **Insects and mites:** scales, spider mites, rust mites, aphids, mealybugs, peach borers
- Dormant sprays control overwintering eggs of insects.

### Areas of Use

Use lime sulphur outdoors as a dormant spray on fruit trees, bushes, and woody ornamentals and during the growing season on foliage of certain woody plants.

### Application Notes

- Dormant sprays are more concentrated than growing season sprays, which are diluted to reduce phytotoxicity
- Spray in early morning or cool of evening to prevent burning

### Precautions

- Do not apply when temperatures are above 26°C
- Do not combine with oil sprays or any other product except as directed on label
- Do not use liquid lime sulphur and dormant oil spray within 30 days of each other during the growing season
- Phytotoxic to dormant apricots, hazelnuts, Delicious apples, *Viburnum* spp., and others
- Phytotoxic to most actively growing plants
- Use growing season spray only on plants listed on label and at the correct dilution
- Do not spray painted woodwork, stone or bricks as staining may result

### Health and Environmental Information

- Moderate toxicity to mammals
- Irritating to eyes, skin and mucous membranes
- Non-toxic to bees, but toxic to beneficial mites
- Non-toxic to fish, birds, bees, and other wildlife and not persistent

# Sulphur

## General Description

- A naturally occurring element
- Broad-spectrum control of fungi, also a miticide
- Binds with fungal spores to prevent their germination
- Sold as ready-to-use and concentrated liquids, dusts, and wettable powders
- No residual effects

## Pests Controlled

- Controls black knot, black spot, leaf spots, powdery mildew, rusts, apple and pear scab
- Controls russet and rust mites

## Areas of Use

Use sulphur outdoors on foliage of vegetables, roses, flowers, other ornamentals, and fruit trees.

## Application Notes

Phytotoxic to some pears, apricots, grapes, raspberries, cucumber, melon or squash, Boston fern, and others (check labels).

## Precautions

- Do not apply when temperatures are 24°C or higher
- Do not combine with oil sprays
- Do not apply within 30 days of dormant or summer oil sprays
- Use only on plants listed on labels as tolerant to sulphur or extreme injury may result

## Health and Environmental Information

- Low toxicity to mammals
- Irritating to eyes and skin
- Non-toxic to bees, but toxic to beneficial mites
- Non-toxic to fish, birds, bees and other wildlife
- Non-persistent (product labels state may be used up to one day before harvest on most edible crops)

# Other Fungicides

## Benomyl

### General Description

- Synthetic fungicide with broad-spectrum effects
- Systemic and residual activity
- Prevents establishment of and controls disease-causing fungi
- Sold as wettable powders
- Sold also mixed with other fungicides, such as captan
- Moderately long residual effects

### Fungi Controlled

**Controls:** apple scab, brown rot, black spot, *Botrytis*, brown patch, cherry leaf spot, dollar spot, *Fusarium*, powdery mildew, stem rots, and other diseases.

### Areas of Use

Use benomyl outdoors on some vegetables, flowers, other ornamentals, fruit and nut trees and bushes, and lawns.

### Application Notes

- Used as a foliar, seed, soil, and turf treatment
- Generally non-phytotoxic (with some exceptions)

### Precautions

- Phytotoxic to some sensitive apple varieties (check labels)
- Do not allow benomyl to become damp during storage as it loses effectiveness

### Health and Environmental Information

- Low mammalian toxicity (product labels state it may be applied up to day of harvest on fruit trees), but a suspected endocrine disrupting chemical
- May cause irritation to eyes, skin, and mucous membranes
- Highly toxic to fish and earthworms, moderately toxic to birds, non-toxic to bees
- Long persistence of several months in plant tissue, 3-12 months in soil

# Triforine

## General Description

- Synthetic fungicide with systemic and residual activity
- Prevents establishment of and controls disease-causing fungi
- Sold as liquid concentrate
- Moderate residual effects

## Fungi Controlled

Black spot and powdery mildew.

## Areas of Use

Use triforine outdoors on roses and other ornamentals (not on edible crops).

## Precautions

Wear eye protection during handling and application as triforine can cause eye damage.

## Health and Environmental Information

- Low to moderate toxicity to mammals
- Low toxicity to fish and bees, earthworms, and other wildlife
- Low persistence in soil

# *Study Questions: Chapter 9 - Fungicides*

*Answers are given in the back of this manual.*

1. a) Which fungicide described is the most toxic to fish, birds and wildlife and the most persistent?

   b) Which fungicides described have systemic effects?

2. List three precautions for using a fungicide product containing elemental sulphur.

CHAPTER 10

# OTHER PESTICIDES: RODENTICIDES AND MOLLUSCICIDES

## Learning Objectives

When you have completed this chapter, you should be able to:

1. *Describe the properties of the pesticides described, including:*
   - *pests controlled*
   - *area of use*
   - *activity and residual effects*
   - *toxicity to people, wildlife or pets*
2. *Describe precautions for using each pesticide.*

## Introduction

This chapter lists the key characteristics of three commonly used rodenticides' active ingredients and one commonly used molluscicide for slug control. The active ingredient is shown on every pesticide product label after the word **GUARANTEE**.
Dispensers should have a good understanding of these pesticides because they are so frequently used (based on a survey of BC vendors).

Dispensers should be able to readily explain how these rodenticides work, the type of pests they control, and safety precautions. There are many less frequently used rodenticides not described here. Dispensers should be able to look up information on these in other reference resources as needed. If a customer has not selected a pesticide and wants to know what to use for a given pest, see Section III, Pest Management.

**Information in this chapter is intended only as a guide.**

**Always apply pesticides according to directions on the label.**

# Rodenticides

## Brodifacoum, Bromadiolone, Warfarin

### General Description

- Anti-coagulant compounds that cause animals to die from internal bleeding
- Sold as solid baits, warfarin is also available as a water soluble formulation

### Controls

Mice and rats

### Areas of Use

- Use outdoors near and around buildings
- Use indoors, such as attics, crawl spaces, and storage rooms

### Application Notes

Baits should be used only in tamper-proof bait-stations. These are sturdy, lockable containers that only allow rodents to get in through small entry holes. Some rodenticides are sold already packaged in disposable bait stations.

- Place bait stations along walls, behind appliances, in attics, in crawl spaces, and in darkened corners
- Stations should be secured so that they cannot be upset or dragged away
- Keep bait stations continuously supplied with fresh bait for at least a 10-15 day period (longer for warfarin)
- Water based formulations of warfarin are for use in areas where water sources for rodents are limited

### Precautions

- Do not put bait stations in areas frequented by children or pets
- Do not place bait stations in food storage, preparation, or eating areas
- Always wear gloves when handling rodenticides as they can be absorbed through the skin

**Be cautious when using these pesticides!**

### Health and Environmental Information

- All rodenticides, especially brodifacoum and bromadiolone, are highly toxic to humans and non-target animals, such as pets and wildlife
- Rodenticides are moderately toxic to fish and birds (warfarin is of low toxicity to fish)

# Molluscicides

## Metaldehyde

### General Description

- Synthetic compound that acts as a stomach poison, also upon contact
- Sold as liquid and solid baits, liquid concentrates
- Moderate residual effects

SLUG & SNAIL COFFEE CAN BAIT PROTECTOR

### Controls

Slugs and snails

### Areas of Use

Use outdoors on the ground between plants. Some products may be applied to foliage of ornamentals (none are for use on edible plants).

### Application Notes

- Liquid formulations are usually applied to soil in a thin band around plants, between rows or around areas to be protected
- Pelleted bait formulations should only be used in bait stations (see illustration) out of reach of children, pets, and other animals
- Foliar spray products may be applied to lawns and foliage of ornamentals
- Some pellet products contain a bitter compound to make it less palatable to animals and birds, however, dogs may still be attracted to eat it

### Precautions

- Do not apply any metaldehyde products to foliage or edible parts of crop plants, use only on soil surface around such plants.

- Keep children, pets, poultry, and other domestic animals away from treated areas. Dogs in particular are attracted to metaldehyde baits and may eat enough to be poisoned. May be fatal ~~to dogs.~~

### Health and Environmental Information

- Moderate mammalian toxicity
- May cause irritation to eyes and skin
- Toxic to birds and other wildlife
- Non-toxic to fish, bees and other insects
- Low persistence in soil and water

# *Study Questions: Chapter 10 - Rodenticides and Molluscicides*

*Answers are given in the back of the manual.*

1. List three precautions for using rodenticides.

2. Describe how to use metaldehyde to reduce the risk that dogs will find it and eat it.

# SECTION III

## Common Home & Garden Pests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CHAPTER 11

# HOUSEHOLD PESTS

## Learning Objectives

When you have completed this chapter, you should be able to:

1. *List the common household pests and describe their general appearance, damage they may cause, and the key features of their biology that are important for their management.*
2. *List methods to prevent these animals from becoming pests.*
3. *List preferred and other control measures for these animals.*

## Introduction

Household pests are often just a nuisance, but some are damaging to food or possessions. Even when pests do get into a house, the problem can often be solved without resorting to applying pesticides. It is particularly important to recommend non-toxic controls and prevention methods for indoor pests because unsafe or incorrect use of toxic pesticides by domestic users presents a greater danger from pesticide exposure than it would outdoors. Children are especially at risk when pesticides are used in their living areas. For stored products pests, the most effective measures usually involve removing the pests' food supply and breeding sites. This includes cleaning up spilled food (especially pet food), tightly covering garbage containers, and freezing stored food and goods to eliminate infestations.

Serious flea or rodent problems, or established carpenter ant infestations, may require professional assistance from a licensed pest control service to eliminate the problem.

When suggesting pesticides for indoor use recommend the least-toxic products and ensure that the specific product is labelled for indoor use. Many products registered for use outdoors are not safe for indoor use.

**Information in this chapter is intended only as a guide.**

**Always apply pesticides according to directions on the label.**

# Ants

## Description

- There are many species of ants in BC and most are not a problem
- Most ants are black or brown, though some are reddish or yellow
- Ants are usually about 5 mm long (range 2 mm to 10 mm long)

## Damage

- Ants are beneficial insects, but a nuisance when they get into homes
- Ants enter homes to search for food (such as crumbs, sweet foods, pet foods, or kitchen garbage), some ant species may nest in or around home foundations
- Ants usually only enter homes for a short period in the spring and early summer
- It can take two to three weeks to see results with baits

## Biology

- Ant larvae are fed by "worker" ants, which are the ones that are seen searching for food
- Ant nests may be in old tree stumps, under rocks or pavement or in soil outdoors
- Ants leave invisible odor trails for other ants to mark the path to a food supply

## Prevention

- To avoid attracting ants, remove food by wiping jam and syrup bottles clean, cover garbage tightly, clean up food spills, seal opened food in containers with tight lids, or store the food in the refrigerator
- To prevent ants from getting in a house, use caulking or weather-stripping to seal cracks and entry points around windows, doors, plumbing outlets in walls, along the bottom of siding, and on top of foundations

## Preferred Controls

- Find out where ants are entering and caulk or seal up entry points (often around windows or doors) and wipe up ants with soapy water to erase their odor trails
- It is usually not necessary to destroy ant nests, but if necessary, ants can be driven out of nests in soil around the foundation by repeatedly flooding the nest with water
- Set out ant baits containing boric acid, worker ants carry the bait to the nest
- Place baits where ants will find them, but out of reach of pets and children
- Apply a very light layer of dust products containing boric acid or silicon dioxide in cracks where ants enter—if kept dry, these products remain effective for years

**Note:** It can take two or three weeks to see results with baits.

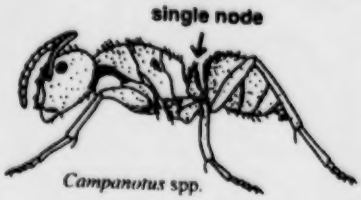
## Other Measures

For severe or persistent infestations that do not respond to the above measures, consult a licensed pest control service to identify the species and recommend an integrated pest management program.

# Carpenter Ants

## Description

- Carpenter ants are common beneficial predators in forests in coastal BC
- All local ant species are either entirely black, or have a reddish middle section
- Worker ants are 6-12 mm long and queens are up to 20 mm long and have wings
- Carpenter ants have a narrow "wasp-waist" and bent antennae, unlike termites which are not indented at the waist and have straight antennae



*Camponotus* spp.

## Damage

- Carpenter ants damage buildings by tunneling into water-damaged wood to make their nests
- Carpenter ants are a nuisance when they search for food indoors (usually early spring)

## Biology

- Queen ants fly in swarms during spring and early summer looking for sites to start new colonies. Most will die off without starting a nest.

- Most main nests are outdoors in moist, decaying stumps, trees, or landscaping timbers, where the permanently damp conditions are suitable for development of eggs and young ant larvae. Main nests are only found in houses where there is damp and decaying wood.

- Most nests in houses are satellite nests, which are offshoots from the main nest. Older larvae and pupae are reared in satellite nests because they tolerate drier conditions. These nests can be in ceilings, eaves, wall voids, or under insulation in attics and crawlspaces.

## Prevention

- Remove and repair any wood damaged by water
- Do not let siding or structural wood touch the soil
- Do not stack lumber or firewood against a house
- Remove all nearby rotted stumps or logs
- Prune trees so branches don't touch house

## Preferred Controls

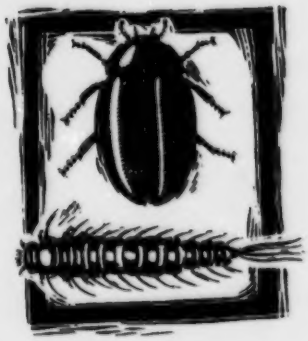
- Find the nest and remove it manually if it can be reached
- Vacuum up the ants or spray with pyrethrins to kill them. Signs of nesting are mounds of loose shavings or sawdust beneath cracks, and rustling sounds in walls (use a rolled up paper tube to listen for noises)
- Follow ants carrying white, oval young to find nests
- Follow ants to the main nest where the queen lives (usually outdoors) and destroy the nest manually or apply pyrethrins

- Prevent ants from re-entering by caulking entry cracks
- Apply a very light dusting of boric acid or silicon dioxide in walls, cavities, and especially on house wiring and plumbing pipes (if possible), these are effective for years if kept dry

## *Other Measures*

For severe infestations or if nests cannot be found, consult a licensed pest control service that will use an integrated pest management approach.

# Carpet Beetles



## Description

- Larvae are oval or carrot shaped, dark brown, bristly, with a tuft of hair at one end, and slow-moving (5-13 mm long)
- Adults are oval, black beetles with brown marks on wing covers

## Damage

- Larvae eat holes in a wide range of natural fibres such as wool, cotton, fur, leather found in furniture, clothing, shoes, and carpets
- Damage is usually concentrated in one area of an item (in contrast to moth damage, which is more scattered)
- Where larva are actively feeding, the site is littered with shed skins and specks of fecal materials

## Biology

- Eggs are laid on natural fibres in dark, quiet places, such as closets, cupboards, and under rugs
- Eggs hatch in 2 weeks
- Larvae feed for 6-24 months, depending on the species, temperature, and food supply

## Prevention

- Clean and properly store vulnerable materials
- Seal cleaned fabrics in plastic bags to store them for long periods
- Use traps instead of poison for rodents, to avoid a rodent dying in an inaccessible place where it would provide food for carpet beetles
- Remove mouse, bird, and wasp nests in and around the home, which are a source of food

## Controls

- Wash or dry clean infested material or freeze items for a week to kill larvae
- Clean and vacuum the area thoroughly, then dispose of vacuum bag
- Apply dusts containing pyrethrins or silicon dioxide to cracks, crevices, floors, and household furnishings

# Fleas

## Description

- Dark brown jumping insects (1 mm long)
- Fleas live on dogs, cats, and other animals, feeding on blood

## Damage

- Bites are annoying and can cause allergic reactions in people and pets
- Can spread pet parasites, such as tapeworms

## Biology

- Adults live on animals
- Flea eggs fall off and hatch where the pet rests
- The larvae live on flecks of dried blood in the pet bedding
- Flea larvae take 1-7 months to develop, depending on conditions, then pupate
- Pupae can remain dormant for up to one year in carpets
- When they hatch into adults, they can bite people even though pets are not present

## Prevention

- Keep pets out of hard-to-treat areas, such as under porches
- Don't allow pets to roam
- Prevent stray animals from entering the yard

## Preferred Controls

- Vacuum frequently and thoroughly, dispose of vacuum cleaner bags after vacuuming
- Shampoo or steam-clean carpets
- Comb pets regularly with a flea comb
- Wash pets with shampoos recommended by a veterinarian
- Wash pet bedding in hot, soapy water every 2-3 weeks
- Spray pet beds, carpets, and floor areas throughout the home with products containing methoprene, which stops development of larvae, and pyrethrins, which controls adult fleas
- Treat the pet's outdoor resting places
- Apply insect parasitic nematodes to outdoor resting areas in the yard to control larvae
- Set out light traps designed to attract fleas in areas where problems persist

**Note:** Do not sell ultrasonic devices to repel fleas. They are not legally registered in Canada because there is no scientific basis for claims made for such devices.

## *Other Measures*

Consult a veterinarian to have the pet placed on a program of oral flea medication. This is an insect growth regulator that can safely be fed to pets in pill form. A new, low toxicity topical flea insecticide is also available from vets who must apply it at the clinic.

For severe or persistent infestations that do not respond to the above measures, consult a licensed pest control service that will use an integrated pest management program.

# Rats and Mice

## Description

House mice are small, slender animals with pointed noses, relatively large ears, and nearly hairless tails. Droppings are dark pellets, about 3 mm long.

Black rats (roof rats) and Norway rats are twice as long as house mice. Rats are common in coastal areas of BC. The droppings are oval pellets 1-2 cm long.

## Damage

- They gnaw on woodwork, insulation, siding, and can cause electrical short circuits by gnawing wiring
- They eat stored food and contaminate it with their droppings and urine
- Can transmit diseases on their feet or in urine
- In some areas, fleas on the rodents carry disease

## Biology

- Rodents breed quickly, producing up to 7 litters of young per year
- Mice make nests of shredded paper, insulation, or other soft materials, in hidden, enclosed spaces
- Black rats nest in ceilings and attics
- Norway rats prefer moist conditions and generally live at ground level

## Prevention

- Block all entry places from the outside with durable materials. Use heavy, welded wire mesh to cover vents, conduits, drains, and other openings that cannot be blocked.
- Eliminate potential hiding places near house foundation, such as firewood, equipment, and dense vegetation.
- Build rat-proof compost piles using heavy 1/2" welded wire mesh (not chicken wire). Do not compost meat scraps.
- Store outdoor garbage in tightly closed, preferably metal, containers.
- Place bird feeders well away from house and prevent seed spills onto ground.
- Stop rats from climbing feeder poles by placing wide metal collars on poles.

## Preferred Controls

- Set many snap-traps at one time, small ones are available for mice, larger ones for rats
- Bait traps with dried fruit, peanut butter, cheese, marshmallows, or onions
- Set live traps or box traps, which are available for mice

**Note:** Devices that emit ultrasound to repel rodents are not recommended because after the initial effect, rodents become used to the sound and learn to ignore it.

## *Other Measures*

As a last resort, use rodent poison baits placed in tamper-proof bait stations. Baits must be placed in areas inaccessible to children, pets, and other animals. Use multiple-dose poison baits (with caution), including diphacinone, chlorphacinone, and warfarin.

**Note:** It is dangerous and illegal to scatter poison baits over the ground or inside buildings!

Customers should be warned about problems with baits, including:

- Poisoned rodents often crawl away to die in inaccessible places in homes, where they decompose and may smell and attract other pests.
- There is a risk of poisoning pets and wild animals that would catch and eat a rodent dying from poison.

**Note:** In areas where warfarin has been used extensively, rats and mice have become resistant to it.

For severe or persistent rodent problems that do not respond to the above measures, consult a licensed pest control service that will use an integrated pest management program.

# Yellowjackets

## Description

- Shiny, yellow-and-black striped wasps, 2 cm long
- Beneficial predators of flies, caterpillars, and other pests

## Damage

Stings are painful, also dangerous for people allergic to insect venom.

## Biology

- In the spring, queen wasps build nests in the ground, in wall cavities or hanging from branches or eaves
- Nests expand all summer as the population grows, but in September all of the wasps die off, except the queen, which overwinters under bark or leaf litter, but the old nest is not re-used

## Prevention

- Remove food that attracts wasps: feed pets indoors, keep garbage cans tightly covered and cleaned, bury fruit and table scraps deep in compost piles
- Pick fruit early in morning or late in evening when yellowjackets are less active
- Keep picnic food covered, cover drinks and drink only through straws in lids

## Preferred Controls

- Set out several yellowjacket traps to attract them away from outdoor picnics and barbecues. Bait traps with ham, fish, cat food, or meat scraps until August. Later in the season jam, honey, or rotting fruit usually works better.
- Remove nests early in the summer while they are small. Remove nests in the evening when wasps are less active. Wear head-to-toe protective clothing or employ a pest control service to remove the nest.
- If the nest is easily accessible, spray pyrethrins into the nest opening while wearing protective clothing. Repeat on successive evenings if necessary. Remove sprayed nests after killing wasps to prevent birds from eating poisoned larvae inside.
- If wasps are in the wall of a building, do not block nest openings as they can chew through into the house interior.

## Other Measures

For inaccessible nests and those far enough above ground to require a ladder, a licensed professional pest control service should be employed to remove or treat the nest.

# *Study Questions: Chapter 11 - Household Pests*

*Answers are given in the back of the manual*

1. Advice regarding preventing damage from carpenter ants should include: not stacking wood against the house, removing nearby rotting logs and stumps, pruning tree branches to not touch the house and .....?

2. Explain why adult fleas can be present in a house many months after pets have been removed.

3. Describe two main problems in using poison baits to control rodents.

CHAPTER 12

# INSECTS AND OTHER PLANT PESTS

## Learning Objectives

When you have completed this chapter, you should be able to:

1. *List the common plant pests and describe their general appearance, damage they may cause, and the key features of their biology important for their management.*
2. *List methods to prevent these animals from becoming pests.*
3. *List preferred and other control measures for these pests.*

## Introduction

One of the best methods of controlling insect pests of plants is to enlist the aid of their natural enemies, the beneficial insects. A ladybird beetle, for example, may eat over 2400 aphids during her lifespan. Beneficial insects include predatory bugs, beetles, flies, lacewings, midges, and numerous tiny parasitic insects. The best protection for these insects is to minimize the use of pesticides in the garden. Many beneficial insects can also be attracted to gardens by planting mixtures of flowers and herbs to provide them with pollen and nectar.

Gardeners can minimize pest damage to plants by using the following preventive methods:

- Plant pest and disease-resistant cultivars
- Ensure plants are healthy and pest-free before purchasing
- Maintain fertile soils, optimum watering and air circulation
- Time planting of annuals to avoid the main generations of certain pests
- Plant a mixture of vegetables, flowers, herbs, and ornamentals

If pests begin to cause unacceptable damage, use prevention and alternative controls where possible. When choosing pesticides, use the least-toxic products and only apply them to plants requiring treatment, not as a routine or broadcast measure. Broadcast applications of insecticides kill off the beneficial insects as well as the pests, which can lead to more serious pest problems later.

**Note:** When selling pesticides for use on home garden plants, it is particularly important to recommend non-toxic controls and preventive methods to reduce the risks to the consumer from unsafely or incorrectly applied pesticides. Always check labels carefully as not all formulations are meant for use on edible plants. If registered for food plants, check the "days to harvest" information to ensure the product can be used as planned and make sure the customer understands this information.

**"When you kill off the natural enemies of the pests, you inherit their work"**

*--C. Huffacker*

**Information in this chapter is intended only as a guide.**
**Always apply pesticides according to directions on the label.**

# Aphids

## Description

- Tiny (2-3 mm long) soft, pear-shaped insects, often green, also grey, black or other colours
- Often in crowded colonies on undersides of leaves, on new foliage and branch tips

## Damage

- Aphids suck plant sap, causing curled and distorted leaves and buds
- Aphids secrete sticky honeydew onto leaves then black sooty mold grows on the honeydew, which can be washed off
- Some aphids spread plant viruses

## Biology

- Aphids give birth to live nymphs continuously, thus colonies develop very quickly
- Overwintering eggs are laid on woody stems or in crevices in bark
- Aphids can reproduce year-round in greenhouses
- Aphids are difficult to control with insecticides, one survivor can reproduce a new colony
- Many species attack only one kind of plant and do not spread to other plants

## Prevention

Avoid over-fertilizing plants with nitrogen because succulent growth attracts aphids.

## Preferred Controls

- Wash aphids off of plants with a strong stream of water, repeating as needed
- Spray plants with insecticidal soap or pyrethrins
- Spray horticultural oil for summer use, on trees and shrubs during growing season
- Spray dormant oil on dormant trees and shrubs to kill overwintering eggs
- Release biological control aphid midges (*Aphidoletes aphidimyza*), available from local suppliers for aphids in trees, shrubs, roses, and vegetables

**Note:** Purchasing lady beetles is not recommended as they fly away from the release site.

## Other Measures

On some mature ornamental trees, apply a band of systemic insecticides, such as dimethoate, to the bark of the trunk (in accordance with the label instructions).

# Beet Leafminers

## Description

Beet leafminer larvae are pale green maggots that tunnel between the upper and lower surface of leaves, causing brownish blotchy patches on leaves.

## Damage

- Beet leafminers attack leaves of beet, chard, spinach, and related plants
- High numbers can kill seedlings, however, older plants with damaged leaves are not likely to be killed

## Biology

- Adults are small flies that lay eggs on underside of leaves
- Eggs hatch into larvae that mine leaves for 1-3 weeks, there are 2-3 generations per year

## Prevention

- Remove nearby dock and lamb's quarters, which are host plants for the beet leafminer
- Cover plants with floating row covers (with edges firmly tucked into soil) to prevent adults from reaching leaves to lay eggs

## Preferred Controls

- Check plants for eggs (clusters of tiny white eggs laid parallel to each other)
- Destroy damaged leaves as soon as noticed to reduce the next generation's numbers

## Other Controls

Once miners are inside leaves they are not affected by insecticides registered for use on food crops.

# Caterpillars, Leaf-Eating

## Description

- Caterpillars have elongated, soft, segmented, bodies with very short legs
- Some are smooth, others have sparse or dense spines or hairs

## Damage

Generally, caterpillars chew large, ragged holes in leaves and/or buds. The presence of droppings (frass) with the damaged leaves or the presence of silken webbing indicates caterpillar attack. Common caterpillars and their host plants are:

- **Leaf rollers**: fruit trees, hawthorn, and roses
- **Ermine moth**: apple and hawthorn
- **Cabbage looper, imported cabbageworm** (white butterfly): cabbage family plants
- **Winter moth, Bruce spanworm**: blueberries, birch, apple, cherry, plum, poplar, oak and other trees
- **Tent caterpillars**: deciduous trees and shrubs
- **Tomato hornworm**: tomato, peppers, and related plants
- **Climbing cutworms**: wide range of vegetables and flowers
- **Spruce budworm**: balsam fir, spruce, and other conifers

Damage to leaves is unsightly, but unless plants are small, there is usually little long-term harm. For example, deciduous ornamentals soon grow new leaves even if defoliated in a severe infestation. However, caterpillars can seriously damage conifers because damaged needles are not replaced. Caterpillars on fruits and vegetables are more likely to require treatment to protect the crop.

## Biology

- Caterpillars are the immature stage of moths and butterflies
- Populations of some species, such as tent caterpillars, reach high numbers every 6-10 years, then become scarce again as their natural enemies control the population

## Prevention

- Remove crop residues and weeds that harbour caterpillars.
- For tent caterpillars, scrape egg masses from branches when trees are dormant. For cabbage loopers or imported cabbageworm, cover small plants with floating row cover fabric.

## Preferred Controls

- Handpick caterpillars or prune out infested branches
- Spray BTK (which controls caterpillars exclusively) or pyrethrins on attacked plants
- Spray dormant oil to kill overwintering eggs on trees

- For winter moth, in October place sticky bands on tree trunks to catch female moths as they crawl up trees to lay eggs; remove the bands in February
- For tent caterpillars, pull down tent caterpillar nests (use gloves) and drown them in soapy water

## *Other Measures*

Caterpillars seriously defoliating tall trees may be difficult to reach with a home sprayer and may require the services of a licensed tree care professional.

# Codling Moths

## Description

- Apples or pears have an obvious entry hole, usually near the blossom end, plugged with brown crumbly droppings
- Caterpillars are pinkish (up to 1.2 cm long) with brown heads, found inside the fruit near the core

## Damage

Caterpillars tunnel inside apples, crabapples, and pears. Damaged fruit cannot be stored or shipped, but undamaged portions can be used for sauces or cooking.

## Biology

- Caterpillars overwinter in cocoons under tree bark or in ground litter
- Adult moths lay eggs on fruit and leaves when apple trees bloom (May, June)
- When the caterpillars hatch in 1-3 weeks, they immediately bore into fruit
- When finished developing they exit the fruit and crawl down the tree trunk to pupate
- There are 2-3 generations per year, 5-8 weeks apart

## Prevention

- Pick up and dispose of all dropped fruit immediately to prevent larvae from exiting to pupate in soil
- Attract birds to the garden in winter as they will eat overwintering cocoons

## Preferred Controls

Wrap corrugated cardboard or burlap bands (10-20 cm wide) around tree trunks starting in mid-July to intercept first generation of caterpillars as they leave the fruit to pupate. Check daily until October and destroy caterpillars and pupae to reduce the size of the next generation.

## Other Measures

Codling moth populations cause serious fruit loss annually, therefore it is important to inspect developing fruit from the time the first petals fall. Apply insecticides registered for use on codling moths, such as permethrin (which is the least toxic of the insecticides registered for this use). Apply as soon as the first larval entrance holes are found in developing fruit and again 2-4 weeks later. To control the second generation, apply insecticides when fresh entry holes are seen from mid-July onward.

In parts of the Okanagan and Similkameen Valleys under the Sterile Insect Release program, it is imperative that home orchardists comply with all codling moth control efforts in effect for the local area, including applying insecticides, stripping fruit, replacing trees, and other measures.

# Cutworms

## Description

Cutworms are fat, greasy gray caterpillars that live in the soil (for climbing cutworms, see Caterpillars, Leaf-Eating).

## Damage

Cutworms eat seedlings and chew off small plants at the soil line.

## Biology

- Cutworms are the larvae of various species of moths that lay their eggs in late summer (September) in the soil under weeds and debris
- Cutworms are most damaging from early May to the end of June

## Prevention

- Protect transplants by placing "collars" around the stem. These can be tin cans or plastic containers with both ends removed or cardboard or tarpaper strips stapled into a circle. The collar should be pressed at least 2 cm deep into the soil around the seedling.
- Avoid cutworms by planting as late as possible in the season.
- Turn over soil several weeks before planting to allow birds to find exposed cutworms.
- In August and September, prevent moths from laying eggs by removing all plant debris and cultivating garden beds to keep them weed free.
- For peas, beans, and other direct seeded plants, sow extra seeds to ensure enough survive to fill the row.

## Preferred Controls

- During the day, search for cutworms just under the soil surface around damaged plants. Usually only a few cutworms are present and once they are removed no further damage results.
- When soil is warm enough for tomatoes, apply insect parasitic nematodes (for example, Microkil®) to soil one week before setting out transplants, water in well.

## Other Measures

Where cutworm populations are severely damaging seedlings, soil drenches of diazinon insecticides registered for cutworm control can be applied around the base of plants.

**Note:** Do not recommend baits mixed with insecticides, such carbaryl, as these are attractive and highly toxic to birds.

# Earwigs

## Description

Earwigs are elongate, reddish-brown to black (1.5 cm long) with prominent rear pinchers.

## Damage

- Seldom more than a nuisance, and generally do not require control
- In high numbers and at certain times of the year, they damage tender plant material, including flowers, corn silks, and ripe fruit

## Biology

- They are scavengers and predators that help control pests, such as aphids in fruit trees
- They feed at night and hide under leaves, planters, and rocks during the day

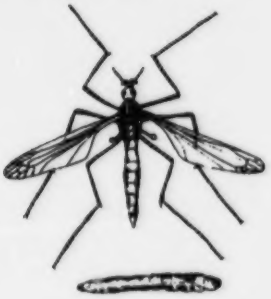
## Prevention

- Eliminate daytime hiding places such as woodpiles, empty flowerpots, and piles of debris near garden beds or along house foundations.
- Keep earwigs out of the house by caulking cracks in siding, foundations, and around plumbing fixtures.
- Use screens and weather-stripping on windows and doors.

## Preferred Controls

- Make traps from tightly rolled up lengths of corrugated cardboard or newspaper, or half-metre lengths of old garden hose.
- Place the traps near plants being eaten, check daily, and shake accumulated earwigs into a bucket of soapy water to kill them.
- Apply a mulch around garden plants being damaged. This gives earwigs an alternative food supply.
- Use floating row covers to protect seedlings.
- Spray insecticidal soap directly on earwigs. Apply pyrethrins to plants being damaged.
- Apply silicon dioxide (diatomaceous earth) dust to cracks, crevices in buildings, and around foundations.

# European Crane Fly (Leatherjackets)



## Description

- Leatherjackets are the brown, shiny larval stage of European crane flies (2-3 cm long)
- Adult craneflies resemble giant brown mosquitoes (2.5 cm long) with very long legs (they are entirely harmless)

## Damage

- Larvae feed on decaying vegetation, fungi and turf roots in the soil from April to mid-May, severely affected lawns develop sparse-looking patches in May or June
- Larvae must be present in high numbers to damage healthy lawns (over 250/$m^2$ or 25/ $ft^2$), unhealthy lawns may show damage from smaller populations
- It is rare for lawns to be damaged as populations are kept in check by natural enemies

## Biology

- Adults emerge in summer and lay eggs on grass or soil; there is one generation per year
- Larvae feed on grass roots in the early fall and remain in the soil for the winter
- When weather warms, larvae resume feeding through May and June, then pupate in the soil

## Prevention

Maintain a vigorous, healthy lawn (see Lawn Weeds, pg. 160, for tips on healthy lawn care)

## Preferred Controls

- Use a mechanical lawn aerator to improves the health of the turf and kill some larvae.
- Sample for leatherjackets if a lawn has continuing damage by folding back sections of turf to expose roots and then count exposed leatherjackets.
- Sample for leatherjackets if a lawn has continuing damage by using a "soap drench" of non-phosphate biodegradable soap in water on a small section of lawn. Count the leatherjackets that emerge in 5-10 minutes.
- Use insect parasitic nematodes (for example, Microkil®) in May, if sampling indicates high numbers (more than 250/$m^2$) of leatherjackets.

**Note:** Microkil® is most effective when spring weather has been warm enough to raise soil temperatures to 12°C.

## Other Controls

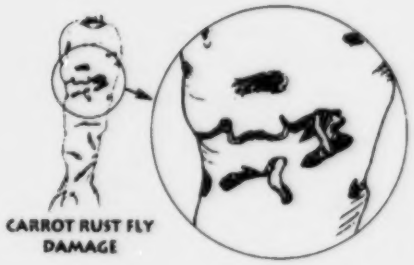
If sampling shows more than 300 larvae/$m^2$, apply diazinon as a spring soil drench on a cool, cloudy day in March to mid-April; poorly-timed treatments are of no value.

**Note:** Routine annual applications of diazinon are wasteful and can make the problem worse in future, as this kills the beneficial insects that control the crane fly larvae in the soil.

# Root Maggots (Cabbage maggot, carrot rust fly, and onion maggot)

## Description

- These are larvae of various species of small flies
- The whitish larvae (6 mm long), called maggots, tunnel in the roots of host plants


CARROT RUST FLY DAMAGE

## Damage

- Maggots tunnel in roots, which kills a plant directly or by allowing disease organisms to enter through injury
- Affected plants wilt in the sun though sufficient moisture is present
- Plants attacked:
  - ◊ **Cabbage maggot:** cabbage family plants, including turnip, radish, alyssum, stocks, and mustard
  - ◊ **Carrot rust fly:** carrots, celery, parsnips, and related plants; the tunnels in the roots are filled with rusty brown castings
  - ◊ **Onion maggot:** onions, shallots, and occasionally garlic or leeks

## Biology

- Eggs are laid in soil, close to roots of host plants, and larvae tunnel in roots for 2-4 weeks
- There are 2-3 generations per year, depending on the weather
- The first adult flies emerge from the soil from mid-April to May
- Each generation takes 4-6 weeks, if the fall is warm there may be a third generation in September
- Adults fly close to the ground

## Prevention

If crops are rotated, so susceptible plants are not grown in the same soil the following year, then the following barriers stop flies from laying eggs near roots:

- **Floating row covers** (for example, Reemay®): cover seedlings and transplants, and then hold down edges of cloth with soil or boards. Covers can be left in place over smaller vegetables such as carrots, onions, turnips, and Chinese cabbage, until harvest.
- **Nylon window screen fence:** fence around susceptible plants with the top edge flopped over to the outside.
- **Tar paper:** set out cabbage family transplants with a square of tar paper, about 20 cm x 20 cm, flat to the soil around the stem (cut a slit to the centre and slide paper around stem).

Time planting to avoiding main generation of pests. For example:

- Plant radishes as early as soil can be worked
- Set out fall cabbages after the first week of July

- Harvest early carrots before mid-July
- Sow mid-season carrots after mid-May
- Sow fall carrots for early spring harvest before flies appear (in coastal regions)
- Plant onion sets in mid-May to avoid first generation of flies
- Remove crop debris immediately after harvest and burn or dispose of infested roots

## Preferred Controls

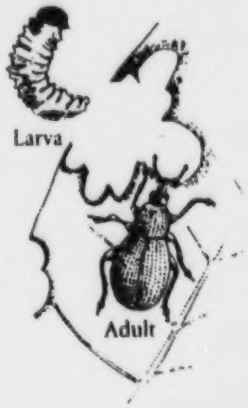
Apply insect parasitic nematodes (for example, Microkil®) to soil around the roots of susceptible plants when the soil is over 12°C; water in well.

## Other Controls

**Note:** Although diazinon is registered for this use, it is not recommended for home gardeners due to the toxicity and persistence of the pesticide.

# Root Weevils *(Black vine weevils, strawberry root weevils)*

## Description




- Weevils are oval, hard-shelled beetles with short snouts
- Black vine weevils are brownish grey or black with small yellow patches on their backs (8 mm long)
- Strawberry root weevils are shiny, nearly black (6 mm long)
- Root weevil larvae are cream-coloured grubs with brown heads (1 cm long)
- They live in the roots of host plants
- Unless numerous their damage rarely harms plants

## Damage

- Root weevils attack berry plants and ornamentals including rhododendron, azalea, rose, viburnum, and conifers
- Larval feeding on roots stunts or kills plants directly or by allowing disease organisms to enter
- Adults chew characteristic semi-circular notches along the edges of leaves at night, they hide in the soil during the day

## Biology

- There is one generation per year
- Larvae feed on roots until mid-May, then pupate
- Adults emerge in early June and feed for about a month, then lay eggs in soil or in crowns of host plants
- Larvae burrow into roots to feed, where they will also spend the winter
- Some adults also overwinter in roots and nearby weedy or brushy areas

## Prevention

- Eliminate overwintering sites for adults, such as piles of garden trash near strawberry beds
- Plant rhododendron cultivars resistant to black vine weevil leaf injury

## Preferred Controls

- Drench soil around susceptible plants with insect parasitic nematodes in May when soil warms, and again in August, well watered in.

- Spray pyrethrins on plants as soon as the leaf damage is noticed (inspect plants daily for damage from June 1st, onward), repeating if fresh leaf injury is seen.

- Knock weevils off plants, at night, onto a ground sheet, then drop them in soapy water.

- Attract adult black vine weevils to hiding places during the day, then check and destroy any weevils. Traps include: short pieces of board laid flat under plants, or bands of corrugated cardboard wrapped around stakes driven into the ground beside the plants.

- Catch adults in sticky traps of Tanglefoot on trunks of shrubs with a single stem. Apply glue to a band of tape or plastic around the trunk.

## *Weevil Resistant Rhododendron Cultivars:*

Tested in Washington State: P.J. Messit, Jock, Sapphire, Rose Elf, Cilpinense, Lucky Strike, Exbury Naomi, Virginia Richards, Cowslip, Pride of Leonards Lee, Vanessa, Oceanlake, Dora Amateis, Crest, Rainbow, Point Defiance, Naomi, Pilgrim, Letty Edwards, and Odee Wright.

**Note:** These, and other resistant cultivars, have rolled-under leaf edges, which prevent the weevils from being able to feed on the leaf edge.

## *Other Controls*

Insect parasitic nematodes are the only control for weevil larvae. If these are not available, growers must depend on controlling adults through foliar sprays.

Malathion can be used for adult weevil control, but due to the toxicity and persistence of the product it is not recommended for use by home gardeners.

# Scales

## Description

- Round or oval, waxy, or shell-like bumps (1-5 mm long) without legs or wings
- They can be grey, yellow, white, or brown
- Some have a distinct dimple in the centre or secrete a coating of wax
- The nymphs (mobile young crawlers) are extremely tiny, making a scale infestation hard to detect before adults start reproducing

## Damage

- Scales suck sap from stems and leaves of many houseplants, shrubs, berries, fruit, and ornamental trees
- Feeding weakens plants and stunts growth. In severe infestations, leaves may yellow and drop, and branches or entire plants may die
- Some scales secrete sticky honeydew onto leaves and fruit, which supports growth of unsightly sooty molds

## Biology

- Most scales overwinter as eggs or nymphs on the bark of trees
- Nymphs wander for several hours or days over plants before they settle and become immobile, this is the stage most susceptible to control by sprays
- There are up to six generations of nymphs per year on indoor plants

## Prevention

Inspect houseplants, ornamentals, and nursery stock very carefully before buying them to avoid importing a problem.

**Note:** One infested house plant can infect the others, resulting in a very difficult control problem.

## Preferred Controls

On trees:

- Apply a dormant oil spray just before bud break in spring to kill overwintering scales
- Spray summer oil (horticultural oils for growing season use) on fruit and ornamental trees that can tolerate summer oils
- Prune and destroy severely infested branches and twigs
- Spray insecticidal soap or pyrethrins when nymphs are crawling on branches in spring

On houseplants:

- Scrub off scales using a swab or toothbrush moistened with water or insecticidal soap
- Set houseplants outdoors for the summer, where beneficial insects often control scales
- Discard infested house plants rather than risk spreading the infestation

## *Other Measures*

On mature ornamental trees (check label for species), apply a band of a systemic insecticide, such as dimethoate, to the bark of the trunk in accordance with the instructions.

# Slugs

## Description

- Garden slugs are 3-25 mm long
- Banana slugs are 10-15 cm long
- They can be grey, tan, green, or black; some have darker spots or patterns
- They leave silvery slimy trails where they have traveled
- Slugs mainly feed at night and on overcast or wet days; on bright days they hide in moist, dark places

## Damage

- Slugs feed on decaying matter as well as tender plants
- They make large holes in foliage, stems, and bulbs and can completely consume seedlings and early shoots of garden plants
- Slugs are most numerous and damaging in wet years and in coastal regions, where they may be active most of the year

## Biology

- Slugs can overwinter at any stage of development
- Some species overwinter as eggs, others survive as young or mature slugs
- Eggs are clear, oval or round and laid in jelly-like masses under rocks and in garden debris

## Prevention

- Protect and attract predators, such as ground beetles, garter snakes, toads, lizards, and centipedes. To attract predators maintain permanent walkways of clover, sod, or mulch between garden beds to provide refuges for predators.
- Protect seedlings, early shoots, and small plants with floating row covers or fine screen, but first make sure no slugs will be trapped under the mesh.
- Repel slugs by using copper strips around tree trunks and shrubs. Place copper or zinc screen around cold frames, legs of greenhouse benches, and edges of raised garden beds. Make sure there are no other routes slugs can use to reach plants and that all slugs are removed from area inside barrier. This is an expensive but semi-permanent way to get rid of slugs.

## Preferred Controls

- Attract slugs to hide under raised flower pots, boards, grapefruit rinds, cabbage leaves, or cut raw potatoes. Turn these over and destroy the slugs every morning until their numbers drop, then check weekly.
- Make traps by burying shallow pans with the pan lip flush to soil surface. Fill with beer or other fermenting liquids.
- Use commercially available slug traps with baits containing fermenting grains or yeasts.
- Apply silicon dioxide (diatomaceous earth) around stem or along the row. Renew dust frequently until plants are well established.

## *Other Controls*

Apply liquid formulations or slug tapes containing metaldehyde around plants, plantings, or beds where slug trails are seen. Do not apply liquids to edible parts of plants. Keep children and pets away from treated areas. Pelleted metaldehyde bait formulations are available, but these should only be used in bait stations, out of reach of children or pets. For example, place bait in the bottom of a metal coffee can that has four or five holes punched around the bottom edge and replace the plastic lid.

**Note:** Dogs and cats are attracted to metaldehyde and fatal poisoning can result from ingestion. It is also toxic to wildlife and birds, which may be killed if they feed on the bait or treated areas. Some products have bitter flavouring added (bitrex) to reduce the attraction for pets, making them a preferred choice.

### *Preferred Pesticide: New Slug & Snail Bait In 2000*

A new, least-toxic slug bait, containing **ferric phosphate** (iron phosphate) was registered in 1999 in Canada and is now widely available in garden centres. Studies using the bait showed 85-100% kill of common slug species. This is as effective as metaldehyde, but without the danger to pets, birds and wildlife.

The product:

- contains a food-grade iron supplement, mixed in pasta bait granules.
- causes slugs and snails to stop feeding and dry up; they die in 3-6 days.
- is non-toxic to people, pets, birds, insects, earthworms and other wildlife

Sprinkle the bait granules around plants where slugs are a problem, reapplying in two weeks if necessary.

# Spider Mites (Two-spotted spider mites, European red mites)

## Description

- Spider mites are minute (only 0.3-0.5 mm long)
- They have eight legs and are red, pale green, or yellowish and resemble fine specks of dust
- Two-spotted mites spin fine webs on the undersides of leaves and around tips of new growth

## Damage

- Spider mites attack houseplants, ornamentals, vegetables, fruit and nut trees, berries, and grapes
- Adults and nymphs suck juice from plant tissue
- Damage first appears as yellow speckled areas on leaves
- In severe infestations, leaves turn bronze or yellowed, with brown edges and become brittle
- New leaves and buds are deformed, plants are weakened, leaves drop, and fruit may be stunted
- Damage is most severe in hot, dry conditions

## Biology

- Eggs and adults overwinter in garden debris and crevices in tree bark
- Mites increase very quickly during hot, dry weather; a generation may take only 7 days
- Mites move between plants by crawling and by "ballooning" on silken strands in the wind

## Prevention

- Rinse plants with water or mist them daily to suppress mite reproduction. In summer, lower temperatures and increase humidity in greenhouses as much as possible.
- Preserve native predatory mites in orchards by avoiding the use of pesticides, including sulphur, as much as possible during the growing season.
- Spray dormant oil/lime sulphur on dormant fruit trees to kill overwintering eggs.
- Inspect houseplants and nursery stock for mites before purchasing them to avoid importing a problem.

## Preferred Controls

- Spray infested plants regularly with water to knock off mites and webs and raise humidity.
- Spray plants with insecticidal soap.
- Spray summer oils (horticultural oils) on fruit trees and ornamentals that can tolerate an oil spray.
- Release biological control predator mites, such as: *Metaseiulus occidentalis* for European red mites on fruit trees, *Phytoseiulus persimilis* for two-spotted mites on vegetables, strawberries, flowers, and indoor plants; other species are available from suppliers.

## *Other Measures*

On some mature ornamental trees (check label), apply a band of systemic insecticides, such as dimethoate, to the bark of the trunk in accordance with label instruction.

# Whiteflies

## Description

- Tiny, delicate insects with powdery white wings (1 mm long)
- They congregate in large numbers on the undersides of upper foliage and fly upwards when disturbed

## Damage

- Whiteflies feed on many houseplants, ornamentals, and vegetables, especially cucumber and tomatoes
- Both nymphs (young) and adults suck plant juices
- They excrete honeydew, which supports the growth of unsightly sooty molds on leaves and fruit
- Infested leaves become pale or discoloured
- Plants may wilt, lose leaves, and become stunted and weakened
- Whiteflies can spread plant viruses

## Biology

- Eggs are laid on the undersides of lower leaves; one generation takes 20-30 days
- There are numerous, overlapping generations during warmer seasons
- In warm greenhouses, populations may reproduce all winter

## Prevention

Inspect all seedlings and plants from nurseries before purchase to ensure they are free of whitefly adults and nymphs.

## Preferred Controls

- Hang yellow sticky traps near tops of indoor plants to capture adults
- Vacuum whitefly adults from leaves of indoor plants
- Use biological controls, such as the tiny parasitic wasp, *Encarsia formosa*, in greenhouses, in the spring and summer
- Apply insecticidal soap or pyrethrins to control adults to the undersurfaces of the newer leaves; if the problem is severe, spray plants every three days
- Spray summer oil on woody ornamentals (horticultural oils for growing season use), that can tolerate summer oils (check label)

# Study Questions: Chapter 12 - Insects and Other Plant Pests

*Answers are given in the back of the manual.*

1. For control of root weevils such as black vine weevils, at what time of year should you start to check for adults on plants?
2. Describe the appearance of scale insects.
3. Describe how to make a trap to catch slugs.

CHAPTER 13

# DISEASES OF PLANTS

## Learning Objectives

When you have completed this chapter, you should be able to:

1. *List the common diseases of garden plants and describe their general appearance, damage they may cause, and key features of their biology important for their management.*
2. *List methods to prevent these diseases.*
3. *List preferred and other control measures for these diseases.*

## Introduction

Many common garden plant diseases are caused by fungi. Diseases discussed in this section are all common foliar diseases except for damping off, which affects seeds, seedlings, and cuttings. Root and stem rots are also a problem but are not covered here because foliar diseases are generally of most concern to home gardeners.

## Basic Steps to Prevent Disease

For home gardeners, the most trouble-free approach is to plant disease resistant varieties if these are available. See the tables for rose varieties resistant to certain diseases (pg. 150 and 151). For other resistance information, refer to variety descriptions in plant guides and seed catalogues.

General recommendations for control of fungal diseases include:

- Ensure good air circulation around plants by avoiding overcrowding plants and pruning trees and shrubs to leave adequate space around branches.
- Avoid wetting the foliage of susceptible plants for long periods; this allows spores to germinate and infect leaves. Irrigate in the early morning so that plants dry off quickly. Rather than misting, raise humidity by setting pots on trays containing wet sand or gravel, mist the floor of a greenhouse, or install a humidifier.
- Avoid spreading infections on tools or hands, through splashed water.

Preventive steps are important because once diseases are present they are very difficult to control.

**Information in this chapter is intended only as a guide.**
**Always apply pesticides according to directions on the label.**

# Black Spot Of Roses

## Description

Small to large circular black spots with fringed margins found on leaves.

## Damage

- In mild infections, plants are not greatly affected
- In severe infections, spots become large, irregular blotches, leaves turn yellow and drop, some plants may be defoliated
- Young leaves (6-14 days old) are most susceptible, especially if they are growing rapidly
- The disease is most damaging during warm, wet weather

## Biology

- Overwinter on fallen leaves, in leaf buds and within the canes
- Germinate and infect leaves when temperatures are warm and moisture is present for at least several hours
- Symptoms (black spots) are visible 3-10 days after infection
- Spores are produced throughout growing season, and can cause repeated infections in warm, wet weather; they spread by air currants, water splashes, insects and on garden tools

## Prevention

- Plant black spot resistant varieties (see Tables on pg. 150 and 151).
- Choose a planting site in full sun, ensure good air circulation by spacing and pruning, avoid wetting foliage during watering and water early in the day.
- In the fall, prune seriously affected roses to within 10-15 cm of the graft union to remove overwintering spores within cane tissue.
- Remove prunings and leaf debris from around the base of roses and burn or dispose of in garbage (do not compost).
- Mulch roses, in the spring, to prevent overwintering spores on the ground from being splashed onto plants to re-infect.

## Preferred Controls

- Spray lime-sulphur before buds break in spring to kill overwintering spores
- Prune out infected leaves as soon as seen

## Other Measures

Beginning in the spring, monitor for disease symptoms when temperatures rise above 15°C, especially when weather is humid. If warranted, spray at intervals specified on label to protect young foliage. Use fungicides registered for use on black spot on roses, such as sulphur, copper, and others.

# Table 4: Rose Varieties Resistant to Certain Diseases

| ROSE (*Rosa* spp.) | Black Spot | Powdery Mildew | Rust |
|---|---|---|---|
| **Hybrid Tea** | | | |
| Aztec | H.Res. | H.Res. | M.Res. |
| Bewitched | H.Res. | H.Res. | H.Susc. |
| Charlotte Armstrong | H.Res. | M.Res. | M.Res. |
| Chicago Peace | H.Res. | M.Res. | M.Res. |
| Chrysler Imperial | H.Res. | H.Susc. | H.Susc. |
| Command Performance | H.Res. | Susc. | H.Res. |
| Eclipse | —— | H.Susc. | H.Res. |
| Ena Harkness | H.Res. | H.Susc. | H.Susc. |
| Fragrant Cloud | H.Res. | M.Res. | H.Res. |
| Garden Party | H.Res. | H.Susc. | H.Res. |
| Helen Traubel | H.Res. | M.Res. | M.Res. |
| Irish Gold | H.Res. | H.Res. | H.Res. |
| Kordes Perfecta | H.Res. | H.Res. | H.Susc. |
| Miss All American Beauty | H.Res. | H.Res. | H.Susc. |
| Mister Lincoln | H.Res. | H.Susc. | H.Susc. |
| Mojave | M.Res. | M.Res. | M.Res. |
| Pascali | H.Res. | M.Res. | M.Res. |
| Peace | H.Res. | M.Res. | H.Susc. |
| Pink Peace | H.Res. | M.Susc. | H.Susc. |
| Red Devil | M.Res. | H.Res. | H.Res. |
| Royal Highness | M.Res. | H.Susc. | H.Susc. |
| Tiffany | H.Res. | M.Res. | M.Res. |
| Tropicana | H.Res. | H.Susc. | H.Res. |
| **Grandiflora** | | | |
| Aquarius | H.Res. | M.Res. | M.Res. |
| Camelot | H.Res. | M.Res. | H.Susc. |
| Comanche | H.Res | M.Res. | H.Susc. |
| Montezuma | H.Res. | H.Susc. | H.Susc. |
| Ole | M.Res. | H.Res. | M.Res. |
| Pink Parfait | M.Res. | M.Res. | M.Res. |
| Queen Elizabeth | H.Res. | Susc. | M.Res. |
| Scarlet Knight | M.Res. | M.Res. | M.Res. |
| **Floribunda** | | | |
| Elizabeth of Glamis | H.Res. | M.Res. | M.Res. |
| Europeana | H.Res. | H.Res. | H.Res. |
| Gene Boerner | H.Res. | M.Susc. | H.Res. |
| Pinnocchio | H.Res. | M.Susc. | H.Res. |
| Redgold | H.Res. | M.Susc. | H.Res. |
| Roman Holiday | M.Susc. | M.Susc. | H.Res. |
| Sarabande | H.Res. | H.Res. | H.Res. |
| Spartan | H.Res. | M.Susc. | H.Res. |
| **Shrub Roses** | | | |
| Adelaide Hoodless | H.Susc. | M.Res.* | M.Res. |
| Alexander McKenzie | H.Res. | H.Res. | M.Res. |
| Assiniboine | M.Susc. | Sl.Susc. | H.Susc. |
| Champlain | M.Susc | H.Susc.* | —— |
| Cuthbert Grant | H.Res. | H.Res. | Sl.Susc. |
| Henry Kelsey | M-H.Res. | H.Res. | H.Res. |
| John Cabot | Sl.Susc. | H.Res. | H.Res. |
| John Davis | Sl.Susc. | H.Res. | H-M.Res. |
| John Franklin | M.Res. | H.Res. | M.Susc. |
| Morden Blush | M.Res. | H.Res. | H.Res. |
| Morden Cardinette | M.Susc. | Sl.Susc. | H.Res. |
| Morden Centennial | M.Res. | H.Res. | M.Res. |
| Morden Fireglow | M.Res. | H.Res. | Sl.Susc. |
| Morden Ruby | M.Res. | H.Res. | H.Res. |
| Nearlywild | H.Res. | H.Res. | H.Res. |
| Prairie Joy | H.Res. | H.Res. | H.Res. |
| Prairie Princess | M.Res. | —— | H.Res. |
| Prairie Youth | M.Susc. | H.Res. | Sl.Susc. |
| William Baffin | H.Res.- | H.Res. | H.Res.- |
| Winnipeg Parks | Sl.Susc. | Sl.Susc.* | —— |
| *foetida bicolor* 'Persian Yellow' | H.Susc. | Sl.Susc. | —— |
| *rubifolia* | H-M.Res. | H.Res. | H.Res. |
| *rugosa* hybrid 'Blanc double de Coubert' | H.Res. | H.Res. | H.Res. |
| *rugosa* hybrid 'Charles Albanel' | M.Res. | H.Res. | H.Res. |
| *rugosa* hybrid 'Hansa' | H.Res. | —— | —— |
| *rugosa* hybrid 'Henry Hudson' | H.Res. | H.Res. | H.Res. |
| *rugosa* hybrid 'Jens Munk' | Sl.Susc. | H.Res. | H.Res. |
| *rugosa* hybrid 'Pink Grootendorst | Sl.Susc. H.Res. | —— | —— |
| *rugosa* hybrid 'Therese Bugnet' | Sl.Susc.- H.Res. | —— | Sl.Susc. |

**Notes:**

1) Shrub rose ratings are based on information from the Agriculture and Agri-Food Canada Research Station in Morden, Manitoba. *Rating based on personal experience of D. Woodske, BCMAF.

2) Two ratings indicate dependence on year. Therefore, a low disease year results in more resistance than in a high disease year.

3) The incidence of rust decreases if the stems with the overwintering stage are pruned out and destroyed early in the year.

# Table 5: Rose Disease Ratings

| | Colour | Black Spot | Powdery Mildew | Rust |
|---|---|---|---|---|
| **Hybrid Teas** | | | | |
| Blue Nile | M | M. Res. | M. Res. | Res. |
| Color Magic | PB | M. Res. | M. Res. | M. Res. |
| Dainty Bess | LP | M. Res. | M. Res. | M. Res. |
| Double Delight | RB | M. Res. | M. Res. | M. Res. |
| Electron | DP | Res. | Res. | Res. |
| Folklore | OB | M. Res. | M. Res. | M. Res. |
| Granada | RB | M. Res. | Susc. | M. Res. |
| Headliner | PB | M. Res. | Susc. | M. Res. |
| Heirloom | M | M. Res. | M. Res. | M. Res. |
| Helmut Schmidt | MY | Res. | M. Res. | Res. |
| Honor | W | M. Res. | M. Res. | M. Res. |
| Just Joey | OB | Res. | Res. | Res. |
| Keepsake | PB | Res. | Res. | Res. |
| Las Vegas | OB | Res. | Res. | Res. |
| Medallion | AB | M. Res. | M. Res. | M. Res. |
| New Day | MY | Res. | M. Res. | Res. |
| Olympiad | MR | M. Res. | M. Res. | Res. |
| Paradise | MB | M. Res. | M. Res. | M. Res. |
| Peter Frankefeld | DP | Res. | M. Res. | Res. |
| Polarstern | W | Res. | M. Res. | Res. |
| Precious Platinum | MR | Res. | M. Res. | Res. |
| Princess Margaret | MP | M. Res. | M. Res. | Res. |
| Pristine | W | M. Res. | M. Res. | Res. |
| Silver Jubilee | PB | Res. | Res. | Res. |
| Touch of Class | PB | M. Res. | Susc. | Res. |
| Voodoo | OB | Res. | Res. | Res. |
| **Glandiflora** | | | | |
| Gold Medal | DY | M. Res. | M. Res. | M. Res. |
| Love | RB | Res. | Res. | Res. |
| New Year | OB | Res. | M. Res. | Res. |
| Prominent | OR | M. Res. | M. Res. | Res. |
| Shreveport | OB | M. Res. | M. Res. | M. Res. |
| Tournament of Roses | MP | Res. | Res. | Res. |
| **Florabunda** | | | | |
| Bonica | MP | Res. | M. Res. | Res. |
| Cherish | MP | M. Res. | M. Res. | Res. |
| Class Act | | M. Res. | Res. | Res. |
| Escapade | M | Res. | M. Res. | M. Res. |
| Eye Paint | RB | M. Res. | Res. | Res. |
| French Lace | W | M. Res. | M. Res. | M. Res. |
| Iceberg | W | Res. | M. Res. | Res. |
| Impatient | OR | Res. | Res. | Res. |

| | Colour | Black Spot | Powdery Mildew | Rust |
|---|---|---|---|---|
| **Floribunda cont'd** | | | | |
| Intrigue | M | M. Res. | M. Res. | Res. |
| Little Darling | YB | M. Res. | M. Res. | M. Res. |
| Liverpool Echo | OB | Res. | Res. | Res. |
| Marina | OB | M. Res. | M. Res. | Res. |
| Matangi | RB | Res. | Res. | Res. |
| Orangeade | OR | Res. | M. Res. | M. Res. |
| Play Girl | MP | Res. | Res. | Res. |
| Play Boy | RB | Res. | Res. | Res. |
| Regensberg | PB | Res. | Res. | Res. |
| Sexy Rexy | MP | Res. | Res. | Res. |
| Shocking Blue | M | M. Res. | M. Res. | M. Res. |
| Showbiz | MR | Res. | Res. | Res. |
| Sun Flare | MY | M. Res. | M. Res. | Res. |
| Sunsprite | DY | M. Res. | M. Res. | M. Res. |
| Trumpeter | OR | Res. | Res. | Res. |
| Viva | DR | Res. | Res. | Res. |
| **Climbers** | | | | |
| Altissimo | MR | M. Res. | M. Res. | Res. |
| Dortrmund | MR | Res. | Res. | Res. |
| Dublin Bay | MR | Res. | Res. | Res. |
| Golden Showers | MY | M. Res. | M. Res. | M. Res. |
| Handel | RB | M. Res. | M. Res. | Res. |
| Joseph's Coat | RB | M. Res. | M. Res. | M. Res. |
| Royal Sunset | AB | Res. | Res. | Res. |

Colour Classification

| | | | |
|---|---|---|---|
| AB | = Apricot Blend | MR | = Medium Red |
| DP | = Deep Pink | MY | = Medium Yellow |
| Dr | = Dark Red | OB | = Orange Blend |
| DY | = Deep Yellow | OR | = Orange Red |
| LP | = Light Pink | PB | = Pink Blend |
| m | = Mauve | RB | = Red Blend |
| MB | = Mauve Blend | W | = White |
| MP | = Medium Pink | YB | = Yellow Blend |

**Note:**

1) Cultivars in this table were grown and tested at the Portland, OR, International Rose Test Garden; many also were grown at the Longview, WA Public Library Rose Garden. Cultivars may react differently in other areas of the Pacific Northwest.

From the 1997 PNW Plant Disease Control Handbook.

| **KEY:** | | | | | |
|---|---|---|---|---|---|
| | H.Res. | = Highly Resistant | | H.Susc. | = Highly Susceptible |
| | M.Res. | = Moderately Resistant | | M.Susc. | = Moderately Susceptible |
| | S.Res. | = Slightly Resistant | | Sl.Susc. | = Slightly Susceptible |
| | Res. | = Resistant | | Susc. | = Susceptible |

# Botrytis (Grey mold)

## Description

- Water-soaked spots or lesions on leaves, stems and spent blossoms, which soon develop a characteristic soft, fuzzy, greyish mould growth
- In head lettuce, botrytis begins on leaves in contact with soil and spreads upwards as a slimy rot

## Damage

Botrytis enters plants by infecting dying or damaged tissue of many kinds of vegetables and flowers, both in greenhouses and outdoors. It is a common problem in humid conditions with poor air circulation.

## Biology

- Spores overwinter in soil and on plant debris
- Spores are spread on the wind
- Spores germinate in high humidity, but disease develops only where damaged tissues or dying blossoms allow the fungus entry

## Prevention

- Allow surface of soil to dry slightly between waterings
- Water early in the day so that foliage can dry by nightfall
- Remove dead or dying plant material (old flowers, fruit, or leaves) promptly
- Ensure good air circulation around plants

## Preferred Controls

- Prevention is the most effective approach for this disease
- In greenhouses, increasing ventilation, promoting air circulation and lowering humidity are effective measures

## Other Measures

For serious infections on valuable ornamentals, apply fungicides registered for use on *Botrytis* including benomyl.

**Note:** At time of printing, no Domestic fungicides products were registered for greenhouse or indoor use.

# Damping Off

## Description

- Seeds fail to germinate (seed rot)
- Seedlings develop water-soaked areas on the stem at the soil line
- Seedlings in a flat collapse and die over a day or two

## Damage

- This disease is caused by the spores of several different fungi, which attack seeds, seedlings, and cuttings of many kinds of plants
- Most infected plants die, or are stunted and weak if they survive

## Biology

- Spores are always present in the soil
- Many more spores germinate in cool, wet conditions; damping off is seldom a problem in warm and dry conditions

## Prevention

- Wait until soil has warmed up before planting susceptible seeds outdoors
- Use fresh seed and do not presoak seeds
- Plant seeds at the appropriate depth, in well-drained soil, under warm conditions
- Cover seedlings with a thin layer of sand, perlite or vermiculite to keep surface dry
- Do not overwater seed beds and seedlings
- Maintain good air circulation around seedlings and don't overcrowd seedlings in flats
- Enrich seedling soil mixes with well-aged compost to inoculate the soil with beneficial fungi that suppress damping-off fungi

## Preferred Controls

- Prevention is the best control; once infected, most seeds or seedlings die and fungicides will not save infected plants
- Providing warm, dry conditions immediately may enable some plants in an infected flat to survive; strengthen them by feeding plant with liquid seaweed extract solution

## Other Measures

If damping off has been a serious problem in the past:

- Use fungicide-treated seeds
- Apply fungicides containing oxine benzoate

# Peach Leaf Curl

## Description

Leaves pucker and curl, developing reddish blisters early in the season. Distorted leaves eventually turn powdery grey and drop.

## Damage

- Peaches and nectarines are affected
- New growth may be stunted
- Infected shoots may die back
- Blossoms and young fruit usually drop early in the season
- Severe infections can kill trees, however, most trees grow out of the disease later in the season, though crop may be lost
- Most damaging in coastal BC and worst in years with cool, wet weather in the spring

## Biology

- Spores overwinter on susceptible trees and on the ground around trees
- Germinating spores attack young leaves when buds first swell in the early spring
- The fungus develops within damaged plant tissues and releases a new generation of spores
- Young, developing leaves that are exposed to rain or dew will be infected
- During wet years, the second flush of leaves may be infected

## Prevention

- Plant resistant cultivars, such as 'Pacific Gold', or 'Renton' peach, and maintain vigorous trees
- Plant trees against a building where a roof overhang will keep leaves dry
- For trees that are espaliered on a fence or a wall, build a temporary covering to keep spring rain off of tree while young leaves are most susceptible
- Rake up and destroy fallen leaves and prune out and destroy dead twigs and branches

## Preferred Controls

- Apply dormant sprays of lime-sulphur or copper just before bud break to kill overwintering spores in bud scales
- Apply fixed copper sprays in September, after harvest
- Pick and destroy all affected leaves as soon as symptoms are visible to prevent the fungus from reproducing
- Spray liquid seaweed extracts at least once a month during the growing season; these have been shown to reduce damage, possibly by providing micronutrients to trees

## Other Measures

Fungicides are no use once the disease becomes evident. No other Domestic fungicides are registered for peach leaf curl.

# Powdery Mildew

## Description

Leaves, shoots, fruits, and blossoms are covered by a dusty or powdery white growth.

## Damage

- A wide range of plants are affected, including beans, onions, cucumbers, squash, dephiniums, phlox, roses, zinnias, begonias, fruit trees, grapes, and berries
- Severe infections slow plant growth, and cause leaves to turn yellow or reddish (especially in strawberries) and die
- Flowers may die prematurely; fruit, such as apples, may have a russetted appearance; or fruit, such as grapes, may crack and split

## Biology

- Spores overwinter on and inside older plant tissue, young, vigorous tissue is less susceptible
- Spores are primarily dispersed by wind
- Spreads in warm and humid weather because spores do not require a film of water on the leaves to germinate; heavy rains or overhead irrigation reduce infection by washing off spores
- New spores are produced every four days; powdery growth is visible two days after infection

## Prevention

- Grow mildew resistant cultivars of cucumbers, squash, roses, apples, and strawberries
- Prune plants to improve air circulation and remove and destroy infected leaves
- Clean up all plant debris at season end to remove spore overwintering sites

## Preferred Controls

- Prune and destroy diseased plant portions to prevent further spread
- Rinsing leaves thoroughly on both sides with water at 1-2 weeks intervals has been shown to be an effective control (dry rapidly to prevent germination of other fungi)
- Apply lime-sulphur during the dormant season (before buds break in spring) to reduce overwintering spores
- Apply sulphur dusts or sprays, during the growing season, on plants that can tolerate it (listed on the label)
- Use of anti-transpirants on roses has been shown to also control powdery mildew

## Other Measures

Apply fungicides registered for use on powdery mildew, such as sulphur, copper, and others. Check specific formulations for use on ornamentals, food plants, and greenhouse plants. Follow label instructions for timing of applications.

# Rust

## Description

- Most infections are a characteristic bright orange, powdery growth
- Infections begin as rusty orange, yellow or whitish spots on the undersides of leaves, appearing later on upper side of leaf and may involve stems, flowers, and fruit
- There may be swellings and galls on leaves and stems

## Damage

- A wide range of plants, including asparagus, bean, blackberry, raspberry, carnation, snapdragon, rose, hollyhock, and pears
- Rusts weaken plants and reduce yields
- Severely infected plants drop leaves and may die
- Most infections remain local on plants and usually do not spread internally, but spores are spread by wind

## Biology

- Rust diseases are caused by a group of plant parasitic fungi
- Many rusts are specific to one or two types of plants
- Spores generally overwinter on fallen leaves and inside plant tissue
- Spores are spread by wind, rain, insects, animals, and on unsterilized garden tools
- Rust spreads quickly in warm (18-21°C) conditions when plants are continuously wet for over two hours
- More spores are produced every 10-14 days in summer
- New plant tissue is more susceptible than older tissue, therefore check undersides of new foliage in spring and during other periods of growth

## Prevention

- Grow rust-resistant cultivars (pg. 150-151 for rose varieties).
- Provide good air circulation by proper spacing and pruning.
- Avoid wetting foliage of susceptible plants.
- Use drip irrigation or water plants early in the day to allow them to dry before nightfall.
- Clean up fallen leaves and plant residues at the end of the season to destroy overwintering spores.
- Avoid working among plants while leaves are wet.
- Apply lime-sulphur to deciduous trees and shrubs during dormant season, before buds break in spring, to kill overwintering spores.

## *Preferred Controls*

- Apply sulphur to susceptible plants when warm temperatures coincide with high moisture levels before plants show damage (sulphur prevents spore germination)
- Pick and destroy infected leaves to slow spread of the disease
- Remove infected plants and replace with resistant cultivars

## *Other Measures*

Spray or dust susceptible plants at 7-10 day intervals (check label) with sulphur or other fungicides registered for use on rusts.

# Study Questions: Chapter 13 - Diseases of Plants

*Answers are given in the back of the manual.*

1. What is the way to most completely prevent black spot disease on roses?
2. Describe symptoms of peach leaf curl disease.

CHAPTER 14

# WEEDS AND VEGETATION

## Learning Objectives

When you have completed this chapter, you should be able to:

1. *Describe common weed and vegetation problems in lawns, gardens, and yards.*
2. *List methods to prevent these plants from becoming pests.*
3. *List preferred and other control measures for these plants.*

## Introduction

Weeds are generally vigorous, hardy species, good at taking advantage of growing conditions that might be too poor for more demanding garden plants. Most weedy species are also adapted to grow very rapidly when they get the chance and are the first to colonize bare soils or gaps in turf. Weeds growing in vacant lots, meadows, ditches, and along driveways, provide food and refuge for beneficial insects and bees, prevent soil erosion, stabilize banks, aerate heavy soils, and break up hard-pan layers. Other than mowing to prevent spread of weed seeds, such sites often do not require additional weed control efforts.

It is important for people to know that long-term solutions to weed problems are only achieved through making changes in how the site is managed, planted, or designed. Unless these types of changes are made, the use of herbicides to control weeds leads to further herbicide use because the hardy, fast growing weeds re-colonize the areas left bare by herbicides.

There is a wide variation between people in their tolerance for weeds in lawns, gardens, and around their yards. People should be informed that routine use of herbicides is not necessary to achieve satisfactory control of weeds. It is important to recommend non-toxic controls and preventive methods to reduce the risk of unsafe or incorrect application of herbicides, including the possibility of damaging desirable plants. A common error made by people who use selective herbicides on lawns is that they assume herbicides used in garden beds will kill only "weeds" and not other plants.

**Note:** The use of products that combine herbicides and fertilizers is not recommended as this often results in the unnecessary use of herbicides. Broadcast use of herbicides is also not recommended for domestic lawns for the same reason.

**Information in this chapter is intended only as a guide.**

**Always apply pesticides according to directions on the label.**

# Lawn Weeds (Including clover, creeping buttercup, dandelion, English daisy, plantain, and moss)

## Description

Many "weeds" are attractive and useful plants. For example:

- Clover breaks up compacted soil, produces nitrogen and remains green in dry conditions longer than grasses
- English daisy has pretty white flowers and stays low growing
- Moss thrives in conditions too shady for turf and doesn't need to be mowed

## Biology

The presence of large numbers of common weeds in lawns indicates problems such as low fertility, compacted soil, poor drainage, excessively dry or waterlogged conditions.

## Prevention

Healthy turf is the best weed control because it forms a tough, resilient carpet that can out-compete most weeds. Maintain healthy lawns by:

**Mowing Practices:** Mow lawns (except bentgrass) relatively high (6-7 cm), this strengthens turf roots and shades out weeds, mow the grass often with a sharp blade.

**Fertility:** Leave lawn clippings on lawns to provide nutrients, supplement with slow release turf fertilizers, apply dolomitic lime to maintain soil pH between 6.5 and 7.0.

**Watering:** Water deeply, but infrequently, to encourage deep roots .

**Aeration:** In compacted or heavy clay soils, aerate soil mechanically every year or two (for small areas, use a garden fork).

**Thatch Control:** A layer of thatch up to 1 cm deep is beneficial. Thicker thatch should be removed with a heavy rake or de-thatching equipment. In healthy turf a good population of earthworms will keep thatch to optimum levels.

When seeding new lawns:

- Test soil and apply lime, fertilizer, and amendments as required
- Clear the soil of weed seeds by allowing two weeks for weeds to germinate, then cultivate to kill the seedling and repeat the process
- Choose a seed mix appropriate to the conditions of soil type
- Plant shade-tolerant groundcovers, or cover with bark mulch, gravel, stones, or pavers where turf grasses will not thrive, such as in shady, tree-covered, or heavy-traffic areas

- Reduce weed sources by cutting back flowering weeds along driveways, fence lines, or waste areas before they go to seed
- Avoid moss growth by correcting the conditions that favour it, such as shading, lack of drainage, and poor air circulation

## *Preferred Controls*

- Manually remove rosettes of dandelion, thistle, and plantain in the spring while the soil is moist, and dig out as much of the taproot a possible
- Overseed sparse or patchy lawns with suitable turfgrass mixtures in late winter or early spring
- For moss, spray herbicidal soap products according to label, rake out dead moss, and overseed with shade adapted turfgrass varieties

## *Other Measures*

Spot treat weeds with herbicides registered for control of broad-leaved weeds in turf. Formulations containing combinations of herbicides are useful if there are several different types of weeds present in the treatment area.

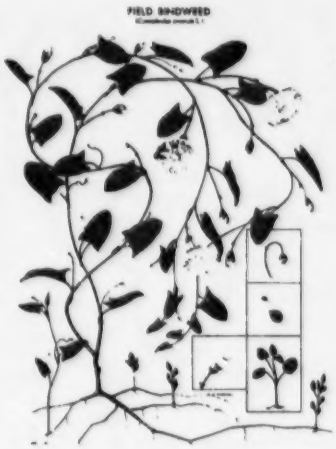
When one weed species is the main problem, choose a herbicide specifically for that plant to get the best results. For example for:

- Creeping buttercup use MCPA, or mecoprop
- Dandelions use 2,4-D or MCPA
- Moss apply ferrous sulphate products according to label

**Note:** Use of products that combine herbicides and fertilizers is not recommended as this often results in the unnecessary use of herbicides. Broadcast use of herbicides is also not recommended for domestic lawns for the same reason.

# Weeds of Garden Beds and Miscellaneous Areas
## (Including blackberry, horsetail, morning glory, thistles, and couch grass)

### Damage




- Weeds in growing beds compete with desired plants for water, nutrients, light, and space
- Weeds in "no-plant" zones, such as cracks in driveways, patios, and paths are unsightly and if left to grow tall, present a tripping hazard and may speed the breakdown of asphalt surfacing

### Prevention

- In perennial beds, grow ground cover plants beneath taller plants and shrubs to compete with weeds
- Mulch with organic materials (leaves, bark) or gravel to smother weeds and prevent seed germination
- Use landscape fabric covered with a mulch around permanent plantings, such as shrub beds

### Preferred Controls

- In areas with hot summer weather, "solarize" unplanted soils to bake weed seeds by leaving a clear plastic stretched over moist and recently cultivated soil (with edges tucked firmly in soil) for 1-2 months
- Hoe, dig, mow weeds, or hand-pull weeds growing within the root zone of cultivated plants
- Remove weeds with as much root as possible before they go to seed
- Smother aggressive perennial weeds by cutting them down, covering the area with a thick layer of mulch and/or an impermeable layer of thick plastic or carpeting, and leave it in place for up to 6 months to kill roots
- Spray annual weeds and weed seedlings with products containing fatty acid herbicide
- Kill weed seedlings by pouring a thin stream of boiling water along cracks and crevices in pavers and other hard surfaces

### Other Measures

- Use herbicides with short residual effect, such as glyphosate, to prepare ornamental beds before planting
- For large, established weeds, cut back foliage to the ground; when new shoots regenerate to a length of approximately 15 cm, spray or wipe glyphosate onto the new growth
- For blackberries, cut plants to the ground in late spring and apply glyphosate on new shoots in late August/early September
- Apply other herbicides registered for use according to label instructions

**Caution:** Most non-selective herbicide products control weeds for a significant amount of time (check label), during which no other plants can be grown either.

**Note:** Most herbicides cannot be used on weeds around desirable plants because they will also kill the non-target plants.

**Note:** Although granular herbicides are registered for control of germinating weed seeds around established ornamentals, instructions for use are complex, and must be applied on weed-free, cleanly cultivated soil. This only works for 6-8 weeks.

# *Study Questions: Chapter 14 - Weeds and Vegetation*

*Answers are given in the back of the manual.*

1. Describe mowing, fertilizing and watering practices to help prevent weeds in lawns.

2. List three approaches to prevent weeds in perennial beds.

CHAPTER 15

# PEST ANIMALS

## Learning Objectives

When you have completed this chapter, you should be able to:

1. *List the common animal pests of gardens and the damage they may cause.*
2. *List methods to prevent these animals from becoming pests.*
3. *List preferred and other control measures for these animals.*

## Introduction

The main approach to wildlife and domestic animal problems in home gardens and yards is to protect plantings with fencing or screen barriers of some type, or by using various scaring devices to change the behavior of the animals. Repellent chemicals are also available, but most are limited in use on or around food plants, and must be renewed frequently to maintain effectiveness.

**Information in this chapter is intended only as a guide.**

**Always apply pesticides according to directions on the label.**

# Birds (Including Crows, Gulls, Robins, Sparrows, Starlings, and Pigeons)

## Damage

- A few species of birds eat seeds, seedlings, fruit, berries, and nuts
- Species that roost and nest on buildings create sanitation problems with their droppings

*Starling*

## Biology

- Most bird species are beneficial in the garden as they eat insects pests and weed seeds
- Many bird species that cause problems (such as gulls, robins, and blackbirds) are protected by law and may not be harmed

## Prevention

- Cover fruit bushes, vines, and small fruit trees with bird netting or screen 2-3 weeks before first fruit ripens.
- Protect seeds and seedlings with floating row covers, chicken wire, or other protectors until plants are well established.
- Grow plants with berries preferred by birds (wild cherry, elderberry, and mulberry) to attract them away from domestic fruit.
- Use bird-scaring devices, such as scarecrows, reflectors, and fluttering objects. Birds become accustomed to such devices, therefore move them around the garden every few days.
- String wires 1-2 cm above the surface of roosting spots on fences and buildings.
- Place sticky compounds (polymerized butenes) along roosting areas according to label instructions.
- Apply bird repellents containing denatonium benzoate, to ornamental plants and trees, fence posts, siding, and garbage areas according to label instructions. Never use these products on food, edible plants, or directly on fruit or nuts of trees.

## Other Measures

For serious problems with pigeons, gulls and other birds roosting on, or in, buildings, consult a licensed pest control service to employ an integrated pest management program for problem birds.

# Cats and Dogs

## Damage

- Cats use dry soil under shrubs, cultivated garden soil, and children's sand boxes as litter boxes. Cat feces are a health hazard as they are the source of toxiplasmosis infections in people.
- Dog urine damages plants. Feces are unattractive and unsanitary on lawns and garden areas.

## Prevention

- Use a motion activated water sprayer, (for example, a scarecrow device), to train pets to stay away from particular areas. This method is particularly effective on cats.
- Cover freshly cultivated soil and bare soil areas under shrubs with bird netting, chicken wire, or commercially designed cat mats to keep cats from digging.
- Apply repellents containing denatonium benzoate (an ammonium derivative), methyl nonyl ketone, or pellets or twist-tie products containing essential oils of lemongrass, citronella, and other aromatic plants on, or around, ornamental plants, other garden areas, and on garbage cans to discourage pets. These are not for use on edible plants.
- Place wire fencing around trees and shrubs to prevent urine from reaching trunks and roots.

## Other Measures

Municipal by-laws all have "dogs at large" regulations—strays should be picked up.

# Deer

## Damage

Deer browse succulent plant growth including flower heads, tender new leaves, and the shoots of many types of plants.

## Biology

- Deer get in the habit of visiting "successful" gardens, therefore protecting plants involves changing the deer's habits
- Deer are often more of a problem in gardens when their usual wild forage plants dry up in summer

## Management in Areas with Occaisonal Deer

- Use a motion activated water sprayer to scare deer away from their favorite plants.
- If specific plants are being eaten, enclose them in chicken-wire cages, or cover with screen or floating row covers.
- Laying sections of loose chicken-wire or other fence wire flat on the ground around attractive plants or across pathways discourages deer because their feet get entangled in wire.
- Apply animal repellent products containing ammonia, denatonium benzoate or putrescent whole egg solids. Some repellents are not for use on edible plants and most must be reapplied after rain.
- Grow plants favoured by deer in areas of the yard where there is frequent activity by people, dogs, and other traffic that would startle the deer and keep them from developing a habit of visiting.
- Hanging mesh bags of human hair or bars of soap from trees sometimes works to reduce damage, though results are not consistent. These should be hung about a metre apart on the plants being damaged. The hair bags should be replaced monthly.

## Management in Areas with Many Deer

- Invest in "deer-resistant" plants. Plants deer don't usually eat are listed in garden books (for example, *Sunset Western Garden Guide).* Even in areas with high deer populations, there are some ornamentals that can be grown without significant damage from deer.
- Fence vegetables and ornamentals eaten by deer; woven wire fencing usually must be at least 2 m in height and extend to the ground. A horizontal extension at the top discourages them even further. Other types of fencing, such as electric fences and slanted fences, which are wide rather than high, are also used in some situations.
- Apply animal repellents such as ammonia, denatonium benzoate, or putrescent whole egg solids. Some repellents are not for use on edible plants and most must be reapplied after rain.

## Other Measures

**Note:** Repellents containing thiram are not recommended for home garden use due to the toxicity of the pesticide and its extreme side effects. Also, it is not for use on plants that are to be used for food or feeding purposes.

# Rabbits

## Damage

- Rabbits can extensively damage ornamental and vegetable gardens by digging and browsing on plants
- During the winter, rabbits can kill trees and shrubs by eating the bark and girdling the trunks

## Management

- Fence the garden to keep out rabbits. Low wire fencing is sufficient.
- Cover vegetables with floating row covers. On small plants, such as lettuce and carrots, this can be left in place until harvest.
- Use a motion activated water sprayer (for example, a scarecrow device) to scare away rabbits.
- Wrap young tree trunks with commercial plastic spiral trunk guards or chicken wire to prevent rabbit damage in winter.
- Apply repellents such as ammonia or denatonium benzoate (an ammonium derivative) to plants. Check labels to determine if specific repellent is registered for use on edible plants.

## Other Measures

**Note:** Repellents containing thiram are not recommended for home garden use due to the toxicity of the pesticide (for example, because of side effects, alcoholic beverages should be avoided for 24 hours before or after working with thiram repellants). It is not for use on plants that are to be used for food or feeding purposes.

# Study Question: Chapter 15 - Pest Animals

*The answer is given in the back of the manual.*

1. Name a device to help keep away deer, dogs, cats and rabbits from garden areas that does not involve fencing.

# GLOSSARY

**Active ingredient** – the ingredient in a pesticide formulation that has the pesticidal effect.

**Aerosol pesticides** – small, pressurised containers that release pesticides through a fine opening by the pressure of an inert gas under pressure. When the nozzle is triggered, it produces an extremely fine spray, mist or fog of tiny particles or droplets in the air.

**Annual plant** – a plant that germinates from seed, flowers, produces seed, and dies in the same year; it has a one-year life cycle.

**Anticoagulant** – a compound that prevents blood from clotting. A rat poisoned by an anti-coagulant rodenticide bleeds internally and usually dies.

**Application rate** – the amount of a pesticide product or active ingredient applied to a unit area, such as litres per square meter.

**Bacteria** – one-celled micro-organisms, some of which cause diseases in plants or animals. They can only be seen with a microscope.

**Biological control** – the use of beneficial species, such as predatory and parasitic insects, birds, nematodes, or disease organisms to suppress populations of pests.

**Broadcast application** – an even application of a pesticide over an entire area, as opposed to treating part of the area or only individual plants in the area.

**Broad leafed plants** – most annual and perennial plants, shrubs and trees with wide leaves. Not grasses, conifers or other plants with needles or grass-like leaves.

**Broad spectrum pesticide** – a pesticide that will kill, or affect, a wide range of organisms in addition to the target pests. The opposite of a selective pesticide.

**Buffer zone** – a strip of land between a pesticide free zone and the pesticide treatment area. Pesticides are not applied in the buffer zone; the width of the buffer zone is to ensure that no pesticides or pesticide residues reach the pesticide free zone, either by drifting in the air or moving with surface or ground water.

**Calibrate** – (1) to determine the amount of pesticide being applied through a nozzle of a sprayer, duster or granular applicator over a given area, (2) to mark a container or tank to indicate the volume at certain levels.

**Cartridge filter** (in a respirator mask) – a metal or plastic container filled with absorbent materials that filter fumes and vapours out of the air before they can be breathed by the wearer.

**Caterpillar** – generally the larval, or immature ($2^{nd}$) stage of moths and butterflies (Lepidoptera).

**Caustic** – a corrosive chemical that can burn the skin.

**Concentrate** – opposite of dilute. Concentrated pesticide formulations need to be diluted, usually with water, before use.

**Contact pesticide** – a compound that causes the death of an organism when it comes in contact with it; the pesticide does not need to be eaten or inhaled by the organism to be effective.

**Days to harvest** – the minimum number of days, as stated on a pesticide label, that must be allowed after the final pesticide application before edible crops can be harvested; also called the pre-harvest interval.

**Deciduous plants** – plants that lose their leaves in the fall and have bare branches in the winter.

**Dilute** – to make the strength of a mixture weaker, less concentrated; for example, by adding more water to a pesticide mixture.

**Dormant/dormancy** – the seasonal halt to visible plant growth, usually for the winter season.

**Drift** – with respect to pesticides, this is the movement of pesticide droplets or dust, by wind or air currents, onto areas outside the target treatment area.

**Emulsifiable concentrate** –a liquid pesticide concentrate that is made with an emulsifier to mix well with water to make a spray.

**Exposure** – with respect to pesticides, this is when someone comes in contact with a pesticide, through the skin, by mouth or by breathing it in.

**Formulation** – a mixture of active ingredient(s) with carriers, spreaders or other materials, to improve the storage, mixing and/or application properties of a product.

**Fungi** – A group of often microscopic organisms lacking chlorophyll (green colouring); they grow from microscopic spores. Many fungi cause plant diseases, such as rots, rusts, mildews and blights; some species of fungi attack wood or cause decay in buildings. (Singular: fungus)

**Fungicide** – a pesticide used to control fungi that cause plant diseases.

**Granular pesticides** – a pesticide incorporated into tiny beads of clay or other materials to make relatively coarse particles; they are applied dry using a spreader, seeder or special applicator.

**Grub** – the larval stage of some beetles.

**Herbicide** – a pesticide used to kill plants and control vegetation.

**Host** – with respect to pests, hosts are the living organisms that a pest or parasite depends upon for survival.

**Insects** – an enormous group of organisms, in which the adults have a body divided into three segments (head, thorax and abdomen), with 3 pairs of legs and 1-2 pairs of wings (if present) attached to the thorax.

**Insecticide** – a pesticide used to kill or repel insects.

**Integrated pest management** – a decision making process for managing pest populations that uses a combination of techniques: it includes preventing pest problems, identification, monitoring, use of injury thresholds for decisions, a combination of controls (physical, mechanical, biological, and chemical), and an evaluation step.

**Larva** – the immature, second life stage of an insect; a larva hatches from an egg; most are worm-like, such caterpillars, maggots and grubs. Many pest insects cause the most damage in the larval stage, particularly those that eat plants. (Plural: larvae).

**Maggot** – the larval stage of flies and midges (Order Diptera). Maggots are legless.

**Mites** – minute animals having eight legs in the adult stage. There are harmful and beneficial species. Closely related to spiders.

**Miticide** – a pesticide used to kill or repel mites.

**Mode of action** – the way a pesticide works to kill pests. For example, a poison that works on contact or as a stomach poison.

**Molluscs** – a group of soft-bodied animals, most of which live in water and have shells, such as clams, oysters and mussels; snails and slugs are common land living molluscs.

**Molluscicide** – a pesticide used to control snails and slugs (molluscs).

**Mucous membrane** – the lining of the nose, throat and other cavities of the body that open to the exterior.

**Nematodes** – a group of elongated, cylindrical worms, also called thread-worms or eel-worms. Some species attack roots or leaves of plants, others are parasites on animals or insects.

**Non-persistent pesticide** – a product that breaks down almost immediately after application into non-toxic compounds, or only lasts for a few days before breaking down.

**Non-selective pesticide** – a product that kills or controls a wide range of organisms or related organisms; for example, a non-selective herbicide is one that would kill any plant.

**Parasite** – an organism that lives in or on the body of another organism and obtains nourishment from it.

**Perennial** – a plant that continues to live from year to year. The tops may die back in winter or in drought, but the roots or rhizomes persist to resume growing in favourable conditions.

**Pests** – living organisms, such as insects, weeds, fungi, rodents, and others, that cause damage, irritation or are otherwise troublesome or harmful.

**Pesticide** – any substance or material, other than a device, that is sold or used to destroy, repel or manage a pest.

**Phytotoxic** – Damaging or injurious to plants, often by destroying the protective surface on plant leaves.

**Post-emergence** – after seedlings emerge from the soil surface.

**Pre-emergence** – before seedlings emerge from the soil surface.

**Predator** – a living organism that preys upon another animal. Many birds are predators of insects; many species of insects and mites prey upon other insects.

**Pupa** – the stage between the larva stage and the adult in insects that undergo complete metamorphosis; a non-feeding and usually an inactive stage. (Plural: pupae)

**Ready-to-use pesticide** – a pre-mixed or pre-diluted product for use as it comes in from the container.

**Repellent** – a compound that drives pests away from a treated object, area or individual.

**Residual pesticides** – products that continue to have a killing or repellent effect for a period of weeks or months after application.

**Respirator** – a device worn over the nose and mouth to prevent the wearer from inhaling harmful substances.

**Rodenticide** – a pesticide used to control rats, mice or other rodents.

**Selective pesticide** – a material that destroys or repels a limited group of organisms; for example, a selective herbicide may kill broad leafed weeds in a lawn, without injuring the grass plants.

**Spot treatment** – an application of a pesticide to small, specific areas, such as individual plants or areas less than 15-20 $cm^2$ in size as opposed to a broadcast treatment.

**Sterilant** – a non-selective chemical that kills any organisms; soil sterilant pesticides stop the germination of seeds and growth of plants, usually for long periods of time after application.

**Structural pests** – organisms that can cause damage in or around homes, buildings, or other structures (for example, termites, carpenter ants, rodents and decay fungi).

**Systemic pesticide** – a product that is absorbed into the plant and moves through the plant tissues; for example, a systemic insecticide can move throughout a plant to kill sucking insects.

**Thatch** – in lawns, this is a layer of dead plant material at the roots of the grasses; a certain amount is beneficial in protecting roots from heat, cold and drought, whereas a thick layer smothers roots and blocks fertilizer and water from reaching the soil.

**Toxic** – able to poison a living organism; poisonous.

**Toxicity** – the degree to which substance is poisonous or injurious to a plant or animal. Toxicity is one consideration in assessing the hazard in handling a particular pesticide.

**Vapour** – the gas form of a substance that is generally a solid or liquid at room temperature; not the same as aerosols or mists, which are composed of tiny droplets of liquid suspended in air.

**Virus** – a protein body capable of infecting and multiplying like living organisms within a host plant or animal; usually causing disease.

**Wettable powder** – a powder containing a wetting agent so that it can be readily mixed into water to form a suspension.

# STUDY QUESTION ANSWERS

## *Chapter 1. What is Integrated Pest Management?*

1. f, d, e, i, a, c, b, h

2. Identification, monitoring, action decisions, treatment, evaluation.

3. Compare specimen with pictures, recognize characteristics of damage, consult experts for assistance.

4. To find out the extent of the pest problem and whether it is increasing or decreasing.

5. The injury level is the unacceptable amount of injury or damage.

6. Prevention is important because preventive methods alone are often sufficient to keep pest populations at tolerable levels. These methods also make controls more effective and help prevent the recurrence of pest problems.

7. Biological control is the use of natural enemies to control pests. Recommended example of biological control useful in a home garden (list one): aphid midges, multi-coloured Asian lady beetle, predatory mites, insect parasitic nematodes.

8. The undesirable side effects of pesticide use include: development of pest populations that are resistant to pesticides, exposure of people, pets and other non-target organisms to potential health hazards, and environmental contamination by pesticides.

9. Preferred pesticides are the least toxic to humans, have the lowest impact on non-target organisms, and are the most specific to the target species. Examples: insecticidal soap, insect growth regulators, diatomaceous earth (silicon dioxide).

10. Dispensers should: ensure safe display and storage of pesticides at the vendor site, ensure customers know pesticides can be used only as stated on the label, and be able to advise on pest management and prevention of pest problems.

## *Chapter 2. Pesticide Characteristics and Legislation*

1. c, a, f, d, b

2. Pesticides may be displayed on open shelves provided the pesticides are at least 10 metres away from food, or they must be stored in a pesticide storage room.

3. Exempted pesticides are a group of specified Commercial and Domestic pesticides that are exempted from regulatory requirements for sale and storage under the Pesticide Control Act Regulation.

4. Secure pesticide containers sufficiently to prevent pesticides from spilling or escaping, and from being removed by an unauthorized person. Separate pesticides from other goods to prevent contamination of human or animal food, clothes, household furnishings, and other items.

5. Domestic pesticide products with a poison symbol on the label must be disposed of at collection depots for household hazardous waste. Other Domestic pesticides and empty containers may be put in household garbage.

6. The store does not require a certified dispenser because aerosol sprays (also insect repellents) are Exempted pesticides.

## Chapter 3. Pesticide Handling Guidelines

1. (c)

2. The area should be inspected regularly to look for damaged or leaking containers.

3. (c)

4. (b)

5. Leather gloves are not suitable and neither are dust masks. Leather will absorb pesticides and cannot be properly cleaned. Wearing contaminated gloves will result in pesticides being absorbed into the skin. A dust mask can protect the lungs only from non-toxic dust, not from insecticide dusts, liquid mists or liquid sprays that release toxic vapours.

6. (f)

7. (c)

8. Measuring spoons and cups should be used to measure pesticides, provided they are never used for cooking or eating utensils. They should be kept in the pesticide storage area.

9. (f)

10. Wind will blow the pesticide off target, giving poor results as well as risking contamination of non-target areas.

    Food harvested before the minimum waiting period may contain unacceptably high levels of pesticide residues. The days to harvest for each type of produce are listed on the pesticide label.

12. The greatest potential for environmental damage from pesticide use lies in the risk of harming non-target, living organisms, including pets and wildlife, fish, beneficial organisms and desirable plants.

13. To reduce the risk of environmental damage when pesticides are required, the applicator should: minimize drift, prevent water contamination, prevent animal poisoning, protect beneficial insects, and protect desirable plants.

14. (c)

## Chapter 4. Equipment, Application, and Pesticide Use Calculations

1. Apply spray at a constant pressure and at a regular speed.

2. Any one of the following: ensure that the spreader is not clogged, walk at a regular walking speed, some spreaders should only be opened while being pushed.

3. Equipment must be checked to ensure it is working properly (not leaking or clogged) and must be cleaned before and after use to prevent corrosion and build-up of caked or gummy pesticide residues.

4. It is hard to apply the pesticide at the correct rate.

5. Over-application of pesticides can: damage the area treated; damage or kill plants and other non-target organisms; increase hazard to the applicator; produce excess residue on harvested produce; and cost the applicator more money.

6. A "broadcast treatment" is applied evenly over an entire area. A "spot treatment" is applied to small, specific areas, such as individual plants or areas less than 15-20 $cm^2$ in size.

7. "Spray to drip" means that the spray droplets run together and start to drip off the plants. "Spray to wet surface" means enough pesticide is applied to make the surface damp to the touch, but not to cause the pesticide to run, drip, or puddle.

8. a) area - 12 ft x 18 ft = 216 $ft^2$
   b) conversion: 216 $ft^2$ x 0.093 = 20.08 $m^2$

9. $$\frac{?\ L}{56\ m^2} = \frac{0.5\ L}{4\ m^2}$$

   $$\frac{56\ m^2 \times 0.5}{4\ m^2} = 7\ L$$

10. $\frac{15 \text{ ml}}{\text{L}} = \frac{? \text{ ml}}{7 \text{ L}}$

(15 ml) x (7 L) = 105 ml

11. $\frac{? \text{ ml}}{56 \text{ m}^2} = \frac{250 \text{ ml}}{100 \text{ m}^2}$

$\frac{56 \text{ m}^2 \text{ x } 250 \text{ m}}{100 \text{ m}^2}$ =140 ml

12. $\frac{? \text{ kg}}{56 \text{ m}^2} = \frac{1.5 \text{ kg}}{100 \text{ m}^2}$

$\frac{56 \text{ m}^2 \text{ x } 1.5 \text{ kg}}{100 \text{ m}^2}$

= 840 g or .84 kg

13. a) 105 ml of spray x 2 treatments/year = 210 ml of spray
    b) 140 ml of spray x 2 treatments/year = 280 ml of spray
    c) 840 g of granules x 2 treatments/year = 1620 g of granules (1.62 kg)

14. a) $\frac{210 \text{ ml of spray}}{80 \text{ ml container}}$ = 2.63 containers (3 containers required)

    b) $\frac{280 \text{ ml of spray}}{150 \text{ ml container}}$ = 1.87 containers (2 containers required)

    c) $\frac{1680 \text{ g of granules}}{1000 \text{ g container}}$ = 1.68 containers (2 containers required)

15. $\frac{15 \text{ ml}}{5 \text{ m}^2} = \frac{? \text{ ml}}{100 \text{ m}^2}$

$\frac{15 \text{ ml} \text{ x } 100 \text{ m}^2}{5 \text{ m}^2}$

= 300 ml per 100 $\text{m}^2$

This means that the application rate is too high; the gardener can correct this for a compressed air sprayer by moving the sprayer more quickly (for example, walking faster), decreasing the air pressure, or closing the nozzle opening.

## Chapter 5. Emergency Response

1. (f)

2. (c)

3. The label may contain information on how to deal with a pesticide spill, and should be consulted before going ahead with a clean-up.

4. (b)

5. The basic first aid steps are: prevent additional contamination; check that victim is breathing; get medical aid as soon as possible; and keep victim calm, warm and comfortable.

6. Pesticides can be released as vapours into the air or spread by water used to fight the fire.

7. Safety preparations for fires: install a fire extinguisher for chemical fires; post emergency numbers in the pesticide display area; and notify the fire department that the vendor site contains pesticides.

## Chapter 6. Pesticide Use Reminders

1. List any two of the following common misconceptions customers have about pesticide use: Pesticides are the best way to control pests. Pesticides only kill pests. If some pesticide is good, then more is better. Old products should be used at a higher rate.

2. Using all-purpose products increases the amount of unnecessary pesticide being released into the environment.

3. RTU's are recommended over concentrates because they (list any three): are less hazardous than concentrated chemicals, do not require the user to calculate dilution rates or have special measuring utensils, avoid the risk of spills during mixing, avoid long-term storage of hazardous concentrate, and can be disposed of in the garbage, rather than having to be taken to household hazardous waste depots.

4. Using spot-sprays reduces the amount of pesticide required, which will: minimize health risks, minimize the risk of harming the environment, and save the customer money.

5. Before using pesticides indoors, remove pets (including birds) and children's toys from the area. Remove all food, dishes and utensils before kitchen cabinets are treated. For indoor spraying, recommend a trigger pump sprayer or hand-held aerosol applicator.

6. They need to know the life cycle of the insect pest in order to know when to spray.

## Chapter 7. Insecticides

1. a) *Bacillus thuringiensis* b) horticultural oil or insecticidal soap c) boric acid or silicon dioxide

2. (b)

3. (e)

## Chapter 8. Herbicides

1. Foliar herbicides are applied to plant foliage, not to the soil as are soil sterilants. Foliar herbicides persist for 1-4 weeks; soil sterilants have a much longer persistence, from 4 weeks to 12 months or more.

2. 2,4-D, dicamba and mecoprop are specific to broadleaf plants.

3. Any 3 of the following precautions: Do not use in vegetable gardens, flower beds, around shrubs or ornamental plants, or on lawns. Mix concentrates only with clean water. AVOID DRIFT or accidental application to desirable plants. Do not apply if rainfall is forecast for the time of application.

## Chapter 9. Fungicides

1. a.) Benomyl b.) Benomyl and triforine

2. Any three of the following: Do not apply when temperatures are 24°C or higher. Do not combine with oil sprays. Do not apply within 30 days of dormant or summer oil sprays. Use only on plants listed on labels as tolerant to sulphur.

## Chapter 10. Other Pesticides: Rodenticides and Molluscicides

1. Do not put bait stations in areas frequented by children or pets. Do not place bait stations in food storage, preparation or eating areas. Always wear gloves when handling rodenticides as they can be absorbed through the skin.

2. Protect dogs by using pelleted bait formulations only in bait stations, and keeping dogs away from treated areas.

## Chapter 11. Household Pests

1. Removing and repairing wood damaged by water and ensuring no siding or structural wood is in contact with soil.

2. Flea larvae take from 1-7 months to develop, then pupate to become adults. Pupae can remain dormant for up to one year in carpets, then hatch into adults, long after pets may have been removed.

3. Poisoned rodents may die and decompose in inaccessible places, and there is a risk of poisoning pets and wild animals.

## Chapter 12. Insects and Other Plant Pests

1. Adults emerge in early June, so start looking for them then.

2. Scale insects are round or oval waxy or shell like bumps (1-5 mm long) without legs or wings.

3. Make traps by burying a shallow pan with lip flush to soil and place beer or fermenting grain in pan or use commercially available slug traps.

## Chapter 13. Diseases of Plants

1. Plant resistant varieties.

2. Leaves pucker and curl, developing reddish blisters early in the season, distorted leaves eventually turn powdery grey and drop.

## Chapter 14. Weeds and Vegetation

1. Mow lawns often to a height of 6-7 cm (leave quite long), fertilize with slow release fertilizers, maintain good pH, and water deep but infrequently.

2. Grow ground cover plants, apply a mulch of organic materials, or use landscape fabric covered with mulch.

## Chapter 15. Pest Animals

Use a motion activated water sprayer.

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